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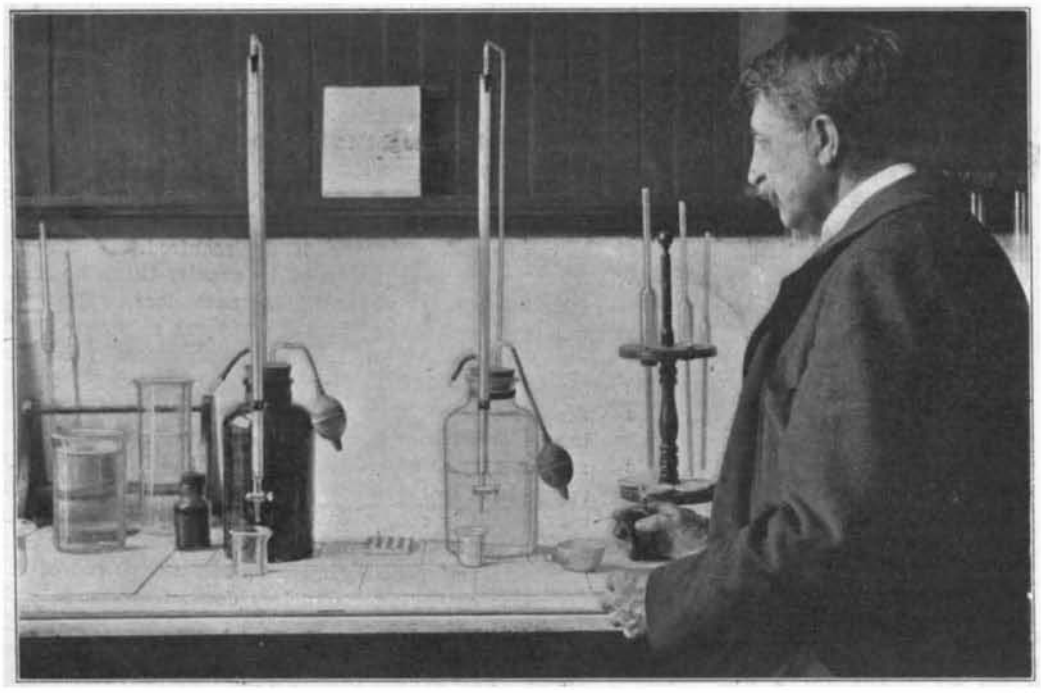

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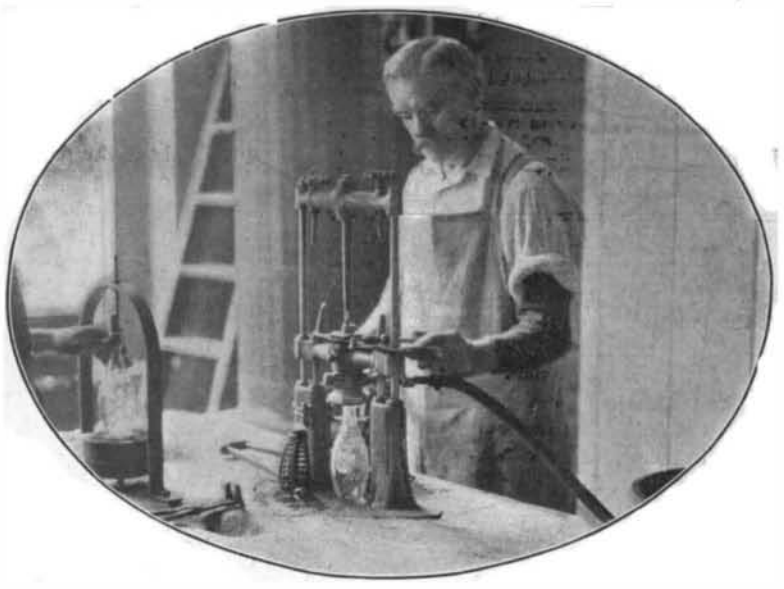
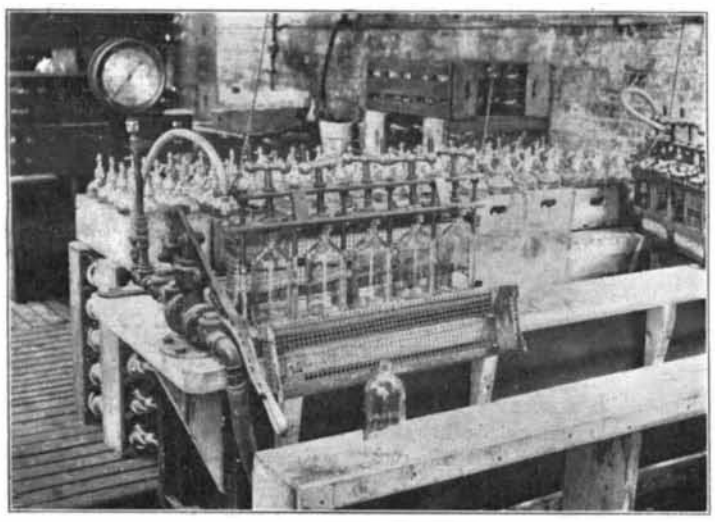
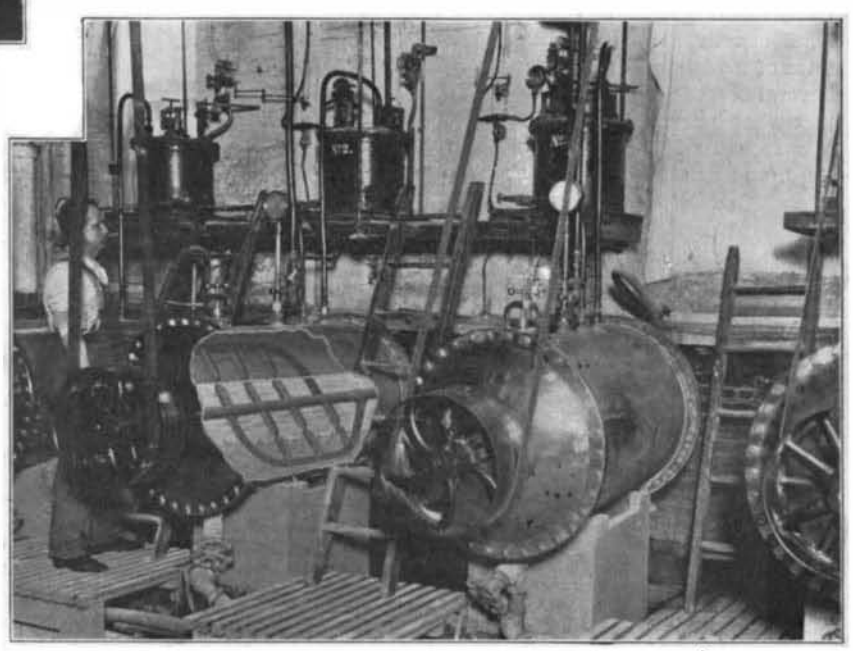


Filling and Wiring Club Soda Bottles.

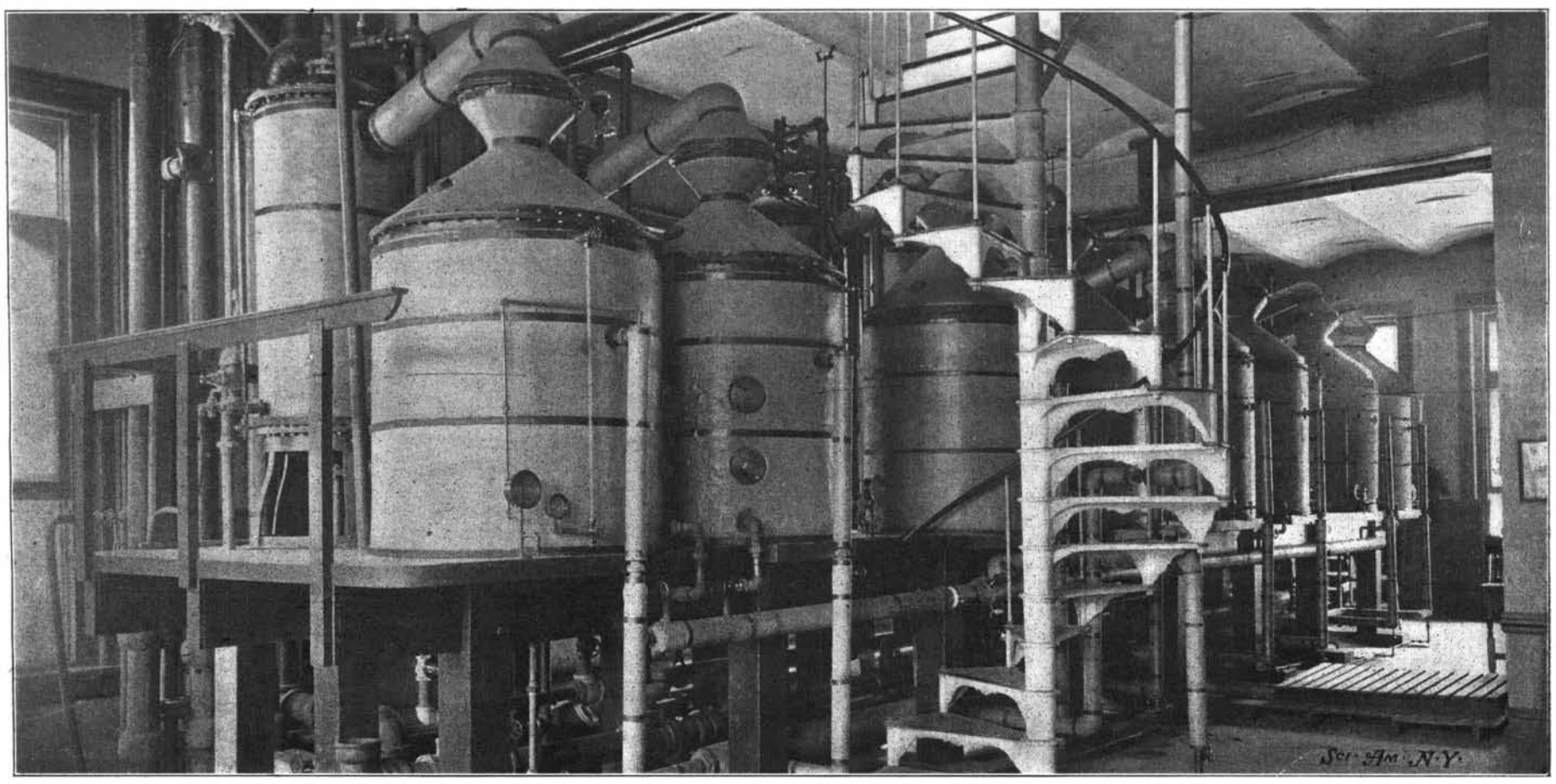


Testing the Siphons.

Section of a Siphon.



Generating the Carbon Dioxide Gas.



The Stills and Condensers.—Capacity 20,000 Gallons a Day.

MANUFACTURE OF CARBONATED MINERAL WATERS.—[See page 165.]

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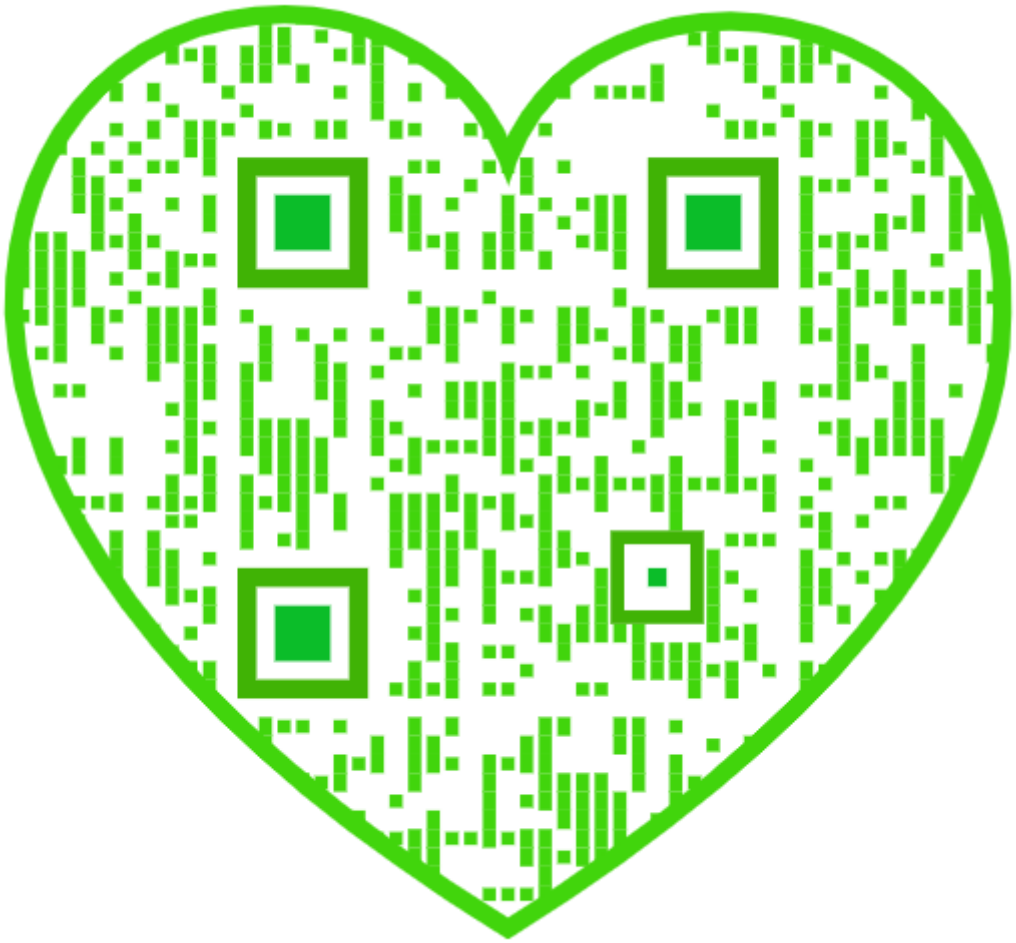

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NEW YORK, SATURDAY, SEPTEMBER 5, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE TRIUMPH OF THE SCOW.

Among the many conditions that contribute to our apparently impregnable defense of the America cup, not the least important is the great popularity in America of the smaller classes of racing yachts, of from 21 to 30 foot measurement, and the rich store of experience which has been gained by our younger architects in the designing and building of these small craft. To the influence of the Seawanhaka cup (which for many years past, in the hands of its present Canadian holders, has seemed about as impregnable as the America cup itself) is no doubt to be largely attributed the development of the vast fleet of small racing craft which forms such a picturesque element in our waters during the summer season. On account of the relatively small cost of these boats, and the absolutely free hand usually given to their designers, every possible form of model and variation of sail plan has been tried. Several seasons ago it had been proved beyond a doubt that what has come to be called the "wholesome" yacht of reasonably large displacement, moderate beam, easy lines, and small sail plan, has no chance whatever in competition with the broad-beamed, shoal, light-displacement craft, with enormous overhangs, which has come to be known by the thoroughly descriptive and generic name of "scow." Of course, the scow has its limitations. In light breezes and a troubled sea it has a way of standing bolt upright, slatting the wind out of its sails, and moving with sluggish and leewardly gait through the water, while its sweeter-modeled and rounder-bodied sister, despite its smaller sail power, was eating its way comfortably to the weather mark. These conditions, however, are comparatively infrequent; and as soon as there was any heart in the wind, the scow moved so fast through the water that the advantage of higher pointing by the other type was easily wiped out, and in nine times out of ten, the boat with the larger sail spread was first home across the finishing mark. It was only a question of time when the success of the scow in the smaller classes should lead to the incorporation, in a modified form, of its principles in the larger yachts. When Gardner brought out his "Weetamoe" and "Neola" and Crowninshield his "Independence," it was proved that with proper modifications the speedy qualities shown by the scow in the 21-footer could be repeated in the 60-foot or 90-foot racing yacht. Had she been the fourth or fifth 90-foot racer to come from the Crowninshield board instead of being the first, there is not the least doubt that "Independence" would have proved much the fastest boat in the "Columbia"-"Constitution"-"Independence" trials. As it was, she contained errors both in form and construction which were due to the facts, first, that her designer followed too closely the lines of his successful 21-footers and secondly that he had no accumulated constructive data to work upon.

We never doubted for a moment that when the new yacht that was to be built by Herreshoff to meet "Shamrock III." made her appearance she would embody the characteristics of shoal body, full waterlines, and long overhangs and excessive sail plan that distinguish the scow type. It was evident that in "Constitution" Herreshoff had developed the normal type to about its ultimate possibilities, and it was pretty certain that, of the rival designers, the one who struck out boldly in the direction of the scow would fly the winning flag in the next series of international contests. When "Shamrock III." came over here and went into drydock it was evident that she conformed entirely to the type of boat to which "Shamrock II.," "Columbia," and "Constitution" belonged, and a great deal of the interest attaching to the present races is due to the fact that in "Shamrock III." we see an attempt to beat the scow type by a vessel of what might be called the normal design. The closeness of the contests proved that Fife has carried the development of the normal type further than Herreshoff was able, for "Constitution," except in absolutely smooth seas and light winds, was never able to push the "Reliance" as closely as "Shamrock III." has done, especially when sheets were hard aboard. What was true of the 21-footer is true of the 90-footer, namely, that the boat with the larger sail spread and smaller displacement will win out against a boat of larger displacement and carrying a relatively small rig. As a matter of fact the displacement of "Shamrock" is about as large if not greater than that of "Reliance"; yet such is the power that is gained from the scow form, that the "Reliance" is able to carry about 14 per cent more sail area on equal or less displacement. It is a great tribute to the skill of Herreshoff that in adopting the scow type he should have modified its objectionable features to such an extent that "Reliance" appears to be relatively just as fast if not faster under conditions supposed to be unfavorable to her type as she is under those in which the scow has hitherto done its best work. It is equally to the credit of Fife that, while retaining the wonderful windward qualities of the more normal boat, he has so improved the reaching qualities that on this point of sailing she is practically a match for the "Reliance" in spite of the 120-foot waterline on which the latter sails when heeled to a scupper breeze.

"SCIENTIFIC HOOLIGANISM" AGAIN.

The claim to perfect secrecy of wireless messages suffered another shock last week during the yacht races, when the Marconi and the De Forest wireless messages were interfered with by some "scientific Hooligan" as Prof. Fleming would call him. The scientific world is still chuckling over the clever work of Mr. Neville Maskelyn in upsetting Prof. Fleming's claim that tuned messages could not be intercepted or interfered with, and the trick was justified on account of Mr. Maskelyn's motive and the fact that he did not maliciously interfere with Prof. Fleming's lecture. Mr. Maskelyn's unknown imitator in this country, however, went to a spiteful extreme in entirely interrupting with floods of profanity and obscenity the news for which the public was eagerly waiting. The perpetrator of such a cowardly deed should be vigorously prosecuted, the act being similar to that of severing telegraph or telephone wires. The difficulty of apprehending such vandals will always be great, and for this reason the question of safeguarding wireless messages should receive renewed attention. The fact that tuning of systems has failed to accomplish all that was required of it is confirmed by the statement of the De Forest Company, that prior to the races an understanding was entered into with the Marconi Company whereby their respective systems should not be worked simultaneously to interfere with each other. The character of the telegraphic signals received on these two systems is very different. In one system the dots and dashes are short and sharp; in the other they are of much longer duration, and we are informed that it is possible for two operators to receive on one receiver messages sent simultaneously from a Marconi and a De Forest transmitter, provided one operator devotes his entire attention to the Marconigram while the other pays strict attention to the De Forest message. Now if, with systems so different in character, it was thought best to make arrangements for non-interference, how much more necessary would it have been to prevent interference in systems using approximately the same length of telegraphic signal.

Wireless telegraphy is essentially similar to heliographic signaling. As the Hertzian waves are invisible, there is used in wireless telegraphy an electric receiver which Lord Kelvin has aptly called the "electric eye." To carry out our comparison, all efforts so far have been made to cause the light flashed out to have such a wave length or color as the "electric eye" is best adapted to receive. The failure of this attempt is due to the fact that the "electric eye" does with varying efficiency receive Hertzian waves of greatly varying lengths, the difference in efficiency being too slight for practical detection. One thing seems to have been forgotten—the "eye" as now arranged is capable of receiving waves from every point of the compass, and similarly, the transmitting station spreads out its waves to all parts of the horizon. Why would not a practical solution of the difficulty be the use of a lens for focusing the rays directly on the "electric eye," and furthermore, of providing "electric spectacles" as some one has called them, for the "electric eyes" themselves? It is well known that Hertzian waves can be readily focused by the use of a lens made of pitch, and such an arrangement would cause the "electric eye" to see most plainly those rays sent from one particular direction, while all outside sources of Hertzian waves would affect it to a comparatively small degree. If necessary, these rays might be screened off by a screen of wire or plate-metal.

THE GREAT SUBWAY POWER PLANT.

New York city contains more power plants of unusual size and capacity than any city in the world, and the remarkable thing is that each successful plant that is built exceeds greatly its predecessors. By far the most imposing of these is the generating station which is now being built to supply power for the Rapid Transit Subway. It is located on the Hudson River at Fifty-eight Street, and the building covers a plot of ground 200 feet in width by 700 feet in length. Its enormous proportions must be seen to be fully appreciated; but a fair idea of its size is gathered when we state that it is nearly twice as large as Madison Square Garden in this city. By the time it is fully equipped, it is estimated that its cost will have reached seven million dollars. When the complete plant has been installed and the station is working up to its fullest capacity, the combined power of the generators will reach the great figure of 130,000 horse power. The great coal bunker which will be constructed immediately beneath the roof and extend the full length of the boiler room, will have a capacity of 25,000 tons, or sufficient, if it were completely filled, to run the plant continuously for nearly a month. The coal will be brought to the docks at the river end of the building, where it will be raised by belt conveyors to an elevation of about 80 feet above the street, carried for the full length of the bunkers, and automatically dumped wherever it is required. From the bunkers it will be drawn off by gravity through chutes which terminate above the furnace doors. Here the coal will be delivered into the hoppers of the mechanical stokers, and after it has done its work in the furnaces, the ashes will be automatically dumped at the rear end of the furnace into hoppers, through which it will flow into ash cars, that run upon tracks to the river, where the ashes will be unloaded into scows. A remarkable feature of the building by which, indeed, it may be easily recognized will be the five great smokestacks, each 265 feet in height, and a novel feature in the construction of these stacks is that, instead of the chimneys extending completely down to ground level, they will be carried by massive steel platforms which will extend 40 feet above the floor of the power house. This is done to save a large amount of valuable space which has hitherto been monopolized by the square base of such chimneys. The building is of the usual steel and masonry type. The architectural features promise to be pleasing and appropriate for the size and character of the structure. The exterior wall consists of cut granite up to a certain level, above which it is built of terra cotta and pressed brick, while the interior is lined with chocolate and cream-colored brick for the first two stories, and above that with an attractive shade of buff brick. In spite of the serious delays which have been caused by strikes, it is expected that this, the largest building in the city, will be completed early in the coming year.

ELECTRICITY ON THE MIAMI AND ERIE CANAL.

Both direct-current motors and polyphase alternating-current motors have been used with more or less success for electric canal haulage, not only in Belgium and other European countries, but also in America. Recently electric haulage has been utilized on the Miami and Erie Canal, and this is said to be the first three-phase traction system in the United States. This canal cost with its reservoirs about $8,000,000, the latter including the grand reservoir of seventeen thousand acres, the Laramie reservoir of nearly two thousand acres, and the Lewiston reservoir of somewhat over seven thousand acres. The canal ranges from 4 to 6 feet in depth, and in width from 40 to 60 feet along the line from Dayton to Toledo and Cincinnati. The electric haulage on this American canal is largely due to Thomas N. Fordyce. The total distance is about 68 miles, and a standard single-track road is provided along the towpath of the canal. From five to seven canalboats are hauled by each electric locomotive, the current being taken from overhead trolley lines, the track acting as the third conductor. The trolley wires range in height from 7 to 22 feet, the former being that used under the various bridges in Cincinnati. The feeders are stranded aluminium wire and the trolley wires are No. 0000 G. E. grooved wires mounted on flexible brackets. The current is supplied from the power plant of the Cincinnati Gas and Electric Company and has a frequency of 60 cycles and a pressure of 4,000 volts.

At the Spring Grove substation the current is reduced in pressure to 400 volts, and in phase is transformed by the Scott method of arranging the transformer connections to two-phase. The voltage of the three-phase on the transmission line along the canal is 33,000 volts, and the frequency 25 cycles per second, and to obtain this pressure motor-generators and step-up transformers are employed at the substation. A 300-kilowatt three-phase generator of 390 volts is driven by a 450-horsepower synchronous motor, which is supplied with the two-phase current entering Spring Grove converter station. The 390-volt three-phase current, which then has a frequency of 25 cycles, is raised in pressure by 250 kilowatt step-up transformers to 33,000 volts.

Step-down substations are located along the canal

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line about a dozen miles apart, and the current is reduced in pressure from 33,000 volts to 1,090 volts for use on the three-phase canal trolley line. The three transformers installed in the substation are connected in delta, and each has a capacity of 150 kilowatts. The substations are 60 feet long, 25 feet wide and 25 feet high, the basement being 7 feet high, and the main floor transformer room 18 feet high. There are seven Baldwin-Westinghouse 20-ton three-phase locomotives to be used, most of which are now in operation. The drawbar pull is 9,600 pounds starting, the coefficient of adhesion being 25 per cent, the voltage on the trolley line 1,100 volts, and the frequency of the current 3,000 alternations per minute. The motors are of 80 horse power capacity each and are wound for 200 volts, which voltage is obtained by further step-down transformers located upon the locomotive. With the two induction motors operating in tandem the speed is about 4 miles per hour, but with one motor only in operation the maximum speed is 6 miles per hour, and the locomotive will haul a full load 10 hours continuously without a maximum rise of temperature of the motors beyond 75 degrees. The transformers on the locomotives are arranged with proper connections for supplying the required current to the motors when the trolley circuit has a pressure of 390 volts, which is the potential used within the city limits of Cincinnati for absolute safety. F. C. P.

THE HEAVENS IN SEPTEMBER.

BY HENRY NORRIS RUSSELL, PH.D.

It is not an easy matter to impart variety to a long series of descriptions of the starry heavens. The moon and planets, to be sure, come and go, and their changing phases and aspects succeed one another quickly enough; but from year to year the stars are altogether the same.

It is only when their positions are determined with the greatest possible accuracy, and when such observations made at long intervals are compared, that we can show that the stars are not absolutely fixed in space. Even then, the great majority of the stars in any catalogue show no certain evidence of any measurable change of position, although they may have been under observation for a century. But, nevertheless, there are many stars which are found to have a small but unmistakeable "proper motion" among their neighbors, and in a few cases this motion is so rapid that it might be proved from the telescopic observations of a single year.

From the standpoint of the naked-eye observer, even such motions are of no account, as it would be some centuries before any change in the star's position would be noticeable, unless it happened to be very near another star, or in line with two others. The greatest known proper motion belongs to a star in the southern hemisphere, too faint to be seen with the naked eye, which moves over more than eight seconds of arc every year. Even at this rate the star takes over 200 years to travel a distance equal to the moon's apparent diameter. A smaller change than this in the position of an isolated star would hardly be detected by mere eye-estimates.

In general, we can therefore be certain that the constellations appear just the same to us as they did to the Egyptian and Chaldean astronomers, and as they will appear five thousand years hence. There will be a different pole-star then as the precessional motion of the earth's axis will cause it to point in a different direction from its present one, but the grouping of the stars themselves will be unchanged, though their position relative to the horizon will be altered.

Only one or two changes in the starry heavens would be great enough to strike the eye, if we could suddenly see them as they will be five thousand years hence. Sirius at that time will be nearly two degrees farther south than he is now, and Arcturus will have moved toward Spica by about 3½ degrees, so that the configurations which these bright stars form with the neighboring small ones will be perceptibly different.

But by far the most important change will be one in the southern constellation Centaurus. Its two brightest stars, Alpha and Beta Centauri, are now about 5 degrees apart and the line through them points westward toward the Southern Cross. Both stars are above the first magnitude, and are very conspicuous. Now Alpha Centauri is moving westward, at the very rapid rate of one degree in about a thousand years, while Beta, which is really enormously more distant than Alpha, has very little proper motion. Consequently, after about 4,500 years, Alpha Centauri will be almost directly between us and Beta, and the apparent distance of the stars will be but a small fraction of what it is now, while the line joining them will be at right angles to its present direction and the whole aspect of that part of the sky will be different.

But this is exceptional. There are a few stars which move faster but none of them are bright enough to be at all conspicuous. On the other hand, there are many groups of stars, such as the Pleiades, which keep together in their motion, so that they will retain their general appearance for centuries. The principal stars of Orion (except for the red Betelgeuse) form such a group, and their motion is so exceedingly slow that all the observations that have yet been made of them hardly enable us to say definitely that they are moving at all. It is practically certain that Orion will look almost exactly the same after 100,000 years as it does now, and it is not improbable that the constellation could still be recognized a million years hence.

At 9 P. M. on September 15, the zenith is occupied by Cygnus, which any one can easily identify as a large cross of stars lying in the Milky Way. The bright star northwest of Cygnus is Vega, and that nearly south of it is Altair. Below the latter is Sagittarius, whose most conspicuous configuration is the little inverted "milk dipper," on the eastern edge of the Galaxy.

Arcturus is near the horizon, a little north of west, and most of the other stars of Boötes are visible above him. The semicircle of Corona Borealis, and the quadrilateral which forms the central part of Hercules, lie between Arcturus and Vega. Ophiucus and Serpens fill the southwestern sky, and a few stars of Scorpio are on the horizon below them.

On the meridian, below Cygnus, is the small but conspicuous group of stars which forms the constellation Delphinus. Lower down is Capricornus with its pair of double stars, which point almost toward Altair. Saturn is below them on the left, and is far brighter. Jupiter, which is some 45 degrees further east, is brighter still, and cannot be mistaken for anything else, especially as he is very much alone in one of the dullest parts of the sky. The brightest star southwest of him is Formalhaut, in the constellation of the Southern Fish.

North of Jupiter—that is, toward the pole-star—is the great square of Pegasus. From its northeastern corner a line of second-magnitude stars runs through Andromeda and Perseus, and points toward Capella, which has just risen in the northeast. Below this line is the oblique triangle which marks the head of Aries.

Cassiopeia is above and to the right of the pole, in the direction of Andromeda. Cepheus is above her, and Ursa Minor and Draco are on the left of the pole. Ursa Major is below them, the dipper being in the only position in which it seems to be right side up.

THE PLANETS.

Mercury is evening star throughout September, but is in an unfavorable position, being far south of the sun. He reaches his greatest elongation on the 7th, when he is 27 degrees from the sun, rather farther than usual. He crosses the meridian more than an hour and a half after the sun, but sets only 45 minutes later. He will consequently be very hard to see, except with a telescope in the daytime. After the middle of the month he rapidly approaches the sun, and disappears from view.

Venus is evening star until the 17th, when she passes through inferior conjunction (that is, between us and the sun), and becomes a morning star. She is, however, not exactly in line with the sun, but is farther south. She will be invisible to the naked eye except during the first few days of the month just after sunset, and the last few days just before sunrise.

Mars is evening star in Libra and Scorpio, but is not now conspicuous. He sets at about 9 P. M. on the 1st, and at about 8:30 on the 30th. At the end of the month he is quite near Antares but both objects are too low to be well seen.

Jupiter is in opposition on the 12th, and is visible all night long. He is in Aquarius, much farther north than last year, and consequently more conspicuous. The markings on his surface, and the changing configurations of his satellites, make him one of the most fascinating of telescopic objects. The most interesting occurrence among his satellites which is visible to us during the month is a transit of the fourth satellite, and a simultaneous occultation of the third, which takes place on the evening of the 10th. Transits or eclipses of one of the satellites are visible almost every night. Their exact times may be found in the Nautical Almanac.

Saturn is in Capricornus and comes to the meridian at about nine o'clock in the middle of the month. He is also a very fine telescopic object.

Uranus is in Ophiucus. He is in quadrature with the sun on the 15th and can only be observed west of the meridian, as he crosses it before dark.

Neptune is in Gemini and is also in quadrature, but on the other side of the sun on the 30th.

THE MOON.

Full moon occurs at 7 P. M. on the 6th, last quarter at 8 A. M. on the 14th, new moon at 11 P. M. on the 20th, and first quarter at 8 A. M. on the 28th. The moon is nearest us on the 18th and farthest away on the 3d, and again on the 30th. She is in conjunction with Saturn on the 3d, Jupiter on the 7th, Neptune on the 15th, Venus on the 20th, Mercury on the 22d, Mars on the 25th, Uranus on the 27th, and Saturn again on the 30th. None of these conjunctions are at all close.

On September 20 there is a total eclipse of the sun, but it is exceedingly improbable that the total phase will be observed, since the track of the shadow is confined to the southern Indian and the Antarctic Oceans. The eclipse is visible as a partial one in the eastern part of South Africa and in Madagascar (where the sun rises eclipsed), and in the southern portions of Australia and New Zealand.

SCIENCE NOTES.

Recent statistics have shown that Germany heads the list as a reading nation, and Russia is falling to zero. In 1893, 23,607 books were published in Germany, as compared with 8,082 in Russia. In regard to newspapers, the inhabitants of the United States are catered to by 22,000 journals, while Russia, with a population of 130,000,000, has only 800. The figures are easily accounted for by the censorship. In Germany the actual number of professional writers is estimated at 12,000, of which number 400 are poets. In behalf of France the assertion is made that she provides the international literature, inasmuch as half the copies of French novels printed are exported, while two-thirds of her historic and scientific works also cross the frontier.

A German scientist, G. Thilenius, has recently brought out some interesting conclusions in regard to the pigmy race, of which some specimens are still met with in the central part of Africa. It is probable that the pigmy races have existed also in Europe, at least in some parts of it. This conclusion is arrived at from the examination of numerous skeletons which have been found in the region of Breslau in Silesia. These skeletons are in a rather bad condition, but it is possible to form a good idea of the height of the individuals which must have existed at least one thousand years ago. Their height is considerably below the ordinary average, being about 4 feet 9 inches, which represents the mean figure for a whole group of skeletons. Similar remains have been found in other parts of Europe not far from the above region; thus Kollman, of Bâle, describes the remains of pigmies which have been found in Switzerland. In this case the average height reaches as low as 4 feet 6 inches. Gutmann has also described the pigmy remains which were found in Lower Alsace, near Colmar. These are still smaller, and the height of many of the specimens is but 4 feet. The pigmy race must be considered as composed of well-formed specimens and not in any way degenerate or pathologic. They seem to have persisted in Europe until a comparatively recent epoch. The pigmies of Silesia appear to have been the contemporaries of the Romans and slave races and to have existed until the year 1000 A. D. At present no specimens are to be found in Europe, and it is only in the central region of Africa that the pigmies are still to be seen.

The British Marine Biological Association has acquired a steam trawler of 200 tons burden for the purpose of investigating the currents and physical phenomena of the North Sea relative to the fisheries therein, in accordance with the International Conference held at Christiania last year. At this congress a comprehensive programme of research was drawn up, to be undertaken jointly by the several powers interested, and it was arranged that the various countries should dispatch specially equipped steamers four times a year, to a specific area in the North Sea, so that simultaneous investigations of the temperature and other physical conditions of the sea over the whole of the area might be made. In the intervals between the periodic crises it was also arranged that special fishing experiments and biological operations were to be carried out. The British government commissioned the Scottish Fishery Board and the Marine Biological Association to carry out the British part of the investigations, and Parliament authorized an award to be equally divided between the two, to defray the cost of the work. The steamer which the British section has acquired has been rechristened the "Huxley," and is 116 feet long, with a speed from ten to twelve knots an hour. The Plymouth laboratory of the Association will be the headquarters of the steamer during the quarterly cruises, and the hydrographic material and the collections of floating life will be investigated there. For the purpose of the North Sea work a small laboratory has been established at Lowestoft, where the fishery work of the North Sea and the investigation of the bottom life will be undertaken. One of the duties of the naturalist on the "Huxley" will be to liberate fishes bearing numbered labels in different parts of the British area. This part of the work is to be carried out on a large scale by all the participating countries, in the hope of throwing light on the migrations and growth of food fishes in the North Sea. The work of the various countries will be published in summary form in annual reports by the International Council.

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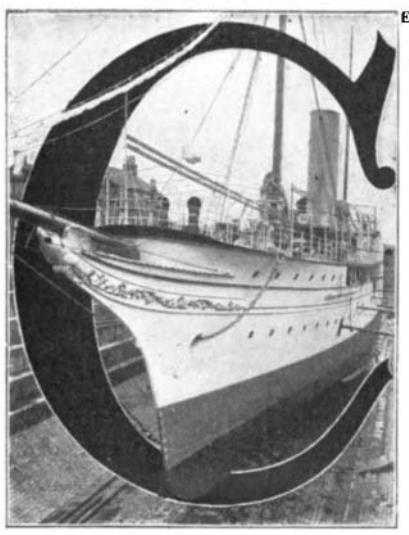
TURBINE YACHTS AT THE INTERNATIONAL RACES.



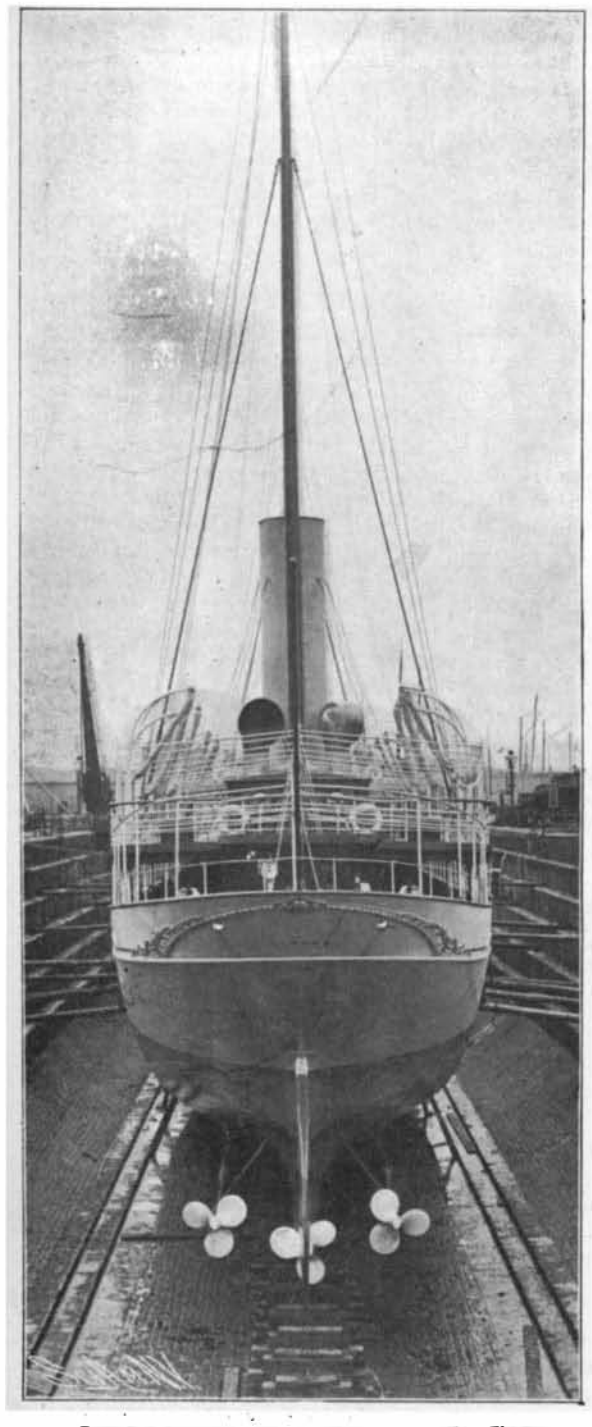
CERTAINLY one of the most attractive features of the international yacht races this year was the presence of several steam yachts equipped with the latest form of motive power for marine propulsion — the steam turbine. Perhaps the most notable of these, because of her high speed, which was exhibited at times, to the great interest of the fleet of sightseers, was Mr. W. K. Vanderbilt, Jr.'s, rakish-looking craft "Tarantula." Originally built for the late Col. McCalmont, who placed speed before every other quality in the yachts that he owned, she was subsequently purchased, through Tams, Lemoine & Crane, by her present owner, and arrived only a few weeks ago at Newport, after making an uneventful trip across the Atlantic. The "Tarantula," which is built upon the conventional lines of the torpedo boat, with sharp V-sections forward, changing to flat U-sections in the after body, has a low freeboard and a comparative absence of deckhouses, and with her two funnels and two pole masts presents a very rakish appearance. She is built of steel, and measures 152.5 feet in length, 15.3 feet in beam, and her depth is 8.4 feet. She has greatly exceeded her designed speed, making 26.75 knots an hour on her trial trip. Her displacement is about 150 tons. As originally constructed, she was designed to carry nine propellers, three on each shaft, but in subsequent trials, three of these were removed, with the result that there was a marked increase in her speed. In the impromptu race which takes place at the conclusion of a cup contest between the steam yachts and excursion boats that witness the finish, it was remarkable to see the "Tarantula" thread her way through the fleet, passing such fast boats as the "Corsair" and "Kanawah," at a speed which made them look to be relatively slow vessels.

Another turbine yacht that possessed special interest for Americans at the race was the "Revolution," which is the first yacht to be driven by a turbine of American make. She is 178 feet over all, 140 feet on the water line, 17 feet in beam, and 7 feet in draft. Her turbines are of the well-known Curtis type, which is now being manufactured in large units for electrical power plants. The engine has shown excellent results. In a report of tests made by Prof. Denton, he says: "The economy found for the turbine is, therefore, probably quite equal at full power to that afforded by average high-speed marine triple-expansion engines and nearly the same for one-tenth of full power." The great advantage of the turbine is, of course, its small weight for the power developed, and the economy of space. The same authority states that the weight of each turbine from its throttle to the exhaust pipe flange is "8 2-3 pounds, and the space occupied one-tenth of a cubic foot, per indicated horse power—figures which are not approached by the average marine engine." Although the "Revolution" has not been designed for such high speed as the "Tarantula," she is, nevertheless, a much faster boat than the average steam yacht. Her lines are handsome, and the graceful sheer, which is one of her marked characteristics, is shown to advantage in the picture of the yacht which we publish.

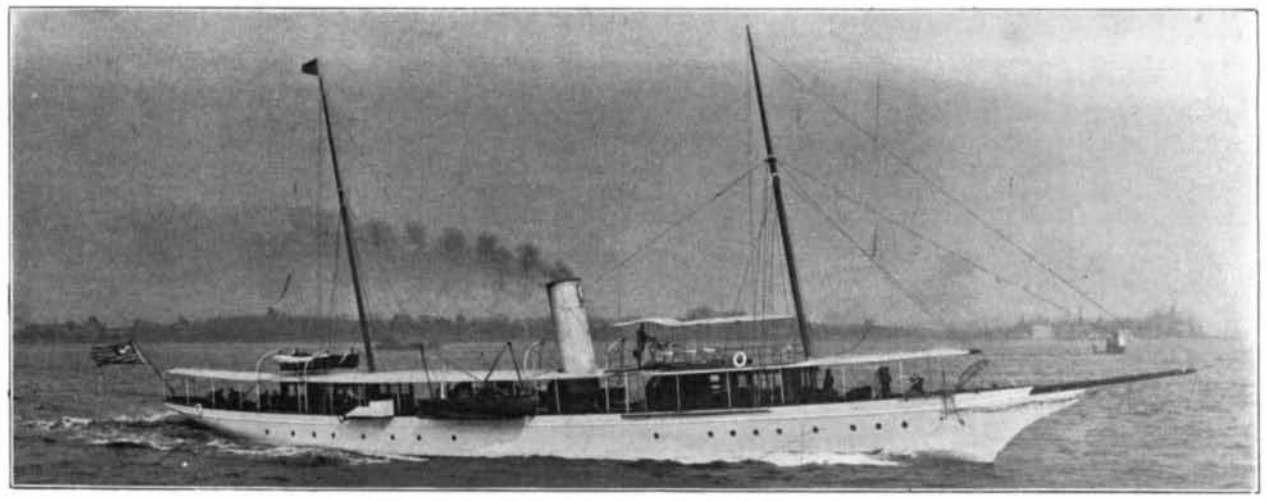
The "Emerald," which is now the property of Mr. George Gould, is another turbine yacht that attracted considerable attention. She is 236 feet in length and 28 feet 8 inches beam, and she has a molded depth of 18 feet 6 inches, and a speed of 16 knots. Her engines, like those of the "Tarantula," are of the well-known Parsons type. As we illustrated this vessel in the SCIENTIFIC AMERICAN of December 13, 1902, the reader is referred to that issue for the various details of this handsome boat.

In this issue we also show views of a large turbine yacht that has recently gone into commission in England, which was built by Ramage & Ferguson, of Leith for Mr. A. L. Barbour, of this city. The new vessel, which is known as the "Lorena," is not only one of the latest and most luxuriously-appointed yachts that have been built in Europe, but she is also one of the fastest, her speed on trial having been just under 19 knots an hour. She does not differ greatly in design or appearance from Mr. G. L. Watson's bigger boats, the most noticeable difference being that the counter is rounded off in a way that is strongly suggestive of older models. If she carried the square stern of the Watson type, she would be distinctly reminiscent of "Varuna." Her length over all is 300 feet; her water line 253 feet, her molded beam 33¼ feet, and her yacht measurement close upon 1,400 tons. She carries a raised deck forward about 60 feet in length, and there is a promenade deck extending through the vessel to within 20 feet of her stern. This latter deck is placed about 7½ feet above the main deck, on which are deckhouses that extend for a length of about 170 feet, provision being made for alleyways on both sides which are about 5 feet in breadth. The vessel has the great advantage of compactness of the engine room which characterizes the turbine-propelled vessel. There are three turbines, one on each shaft, and two condensers. Reversing turbines are provided on each of the outer shafts, after the system which is being followed in the recent turbine-propelled passenger vessels. Instead of carrying five propellers, as in the case of the "King Edward," there are only three, or one on each shaft, as shown in our illustration. The total horse power is 3,200 indicated. The revolution of the center shaft is 530 and of the outer shafts 750 per minute. There are four cylindrical tubular boilers, fitted with Howden's forced draft, and the engines are run under a working steam pressure of 180 pounds to the square inch. It is a remarkable fact that all the turbine yachts that are at present in commission are English-built boats sailing under the flag of American owners.

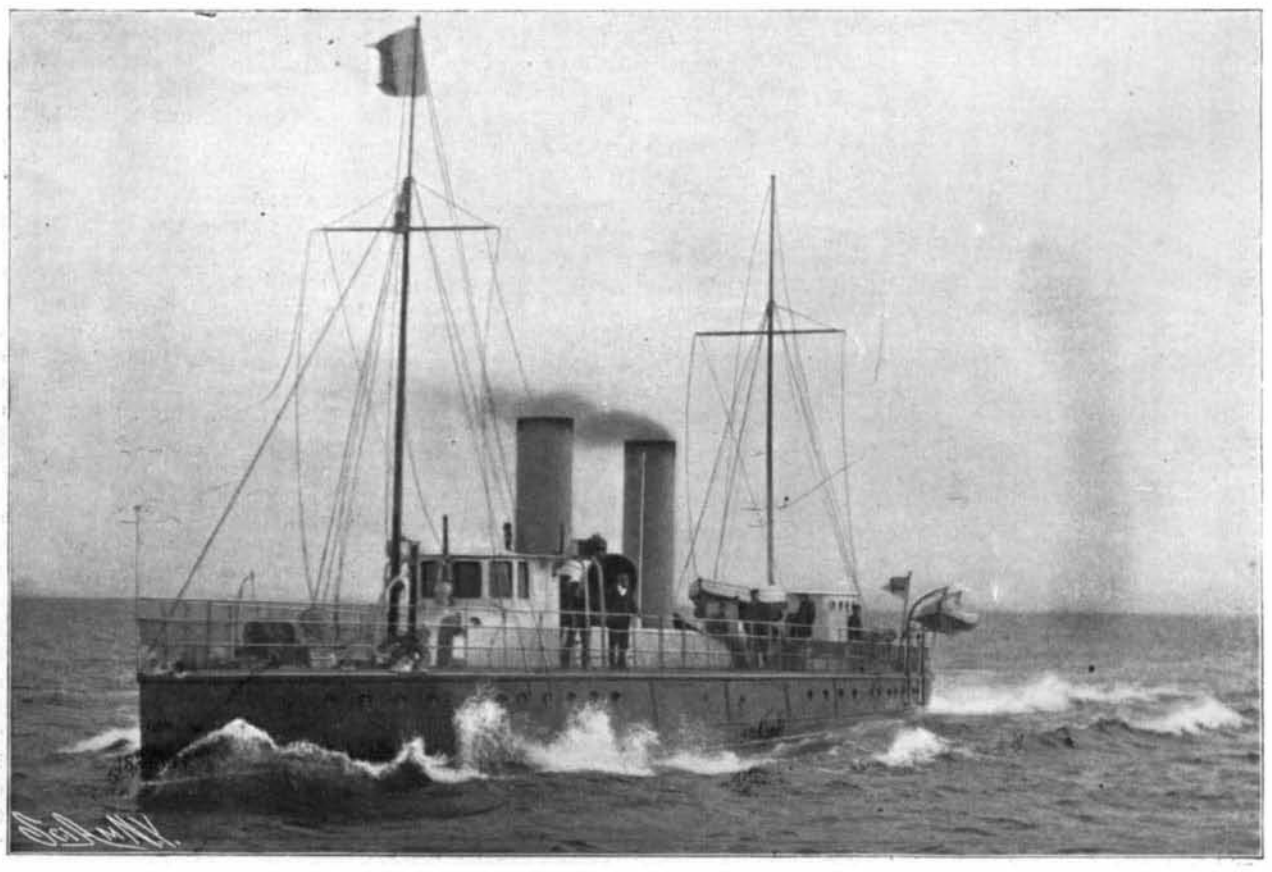
During the recent hot weather at Marseilles some chlorate of potash exploded spontaneously, the explosion being communicated to a line of barrels, one after the other.



Turbine Yacht "Lorena," Showing the Three Propellers.



The "Revolution," First Turbine Yacht Built in this Country.



Turbine Yacht "Tarantula." Speed 26.75 Knots.

TURBINE YACHTS AT THE INTERNATIONAL RACES.

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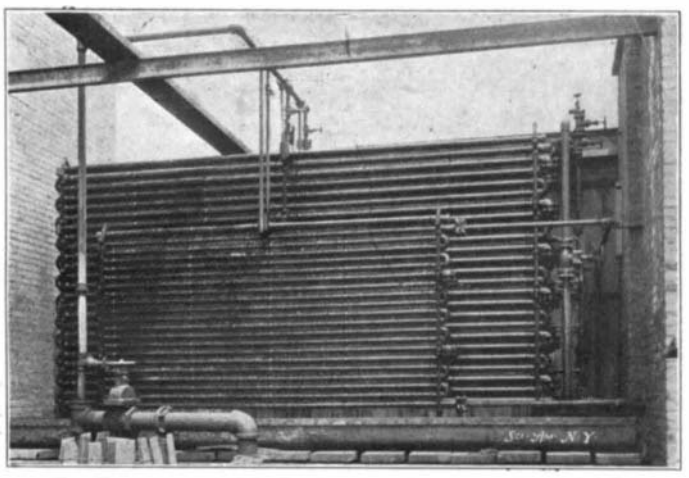
MANUFACTURE OF CARBONATED MINERAL WATERS.

In the year 1772 the English chemist, Priestly, suggested the employment of water impregnated with carbonic acid gas for medicinal purposes, and fifteen years later Selters water was being made at Stettin, Germany. The manufacture of carbonated water in the United States began in the early part of the century, and in 1810 a patent was granted for saturating water with "fixed air." It was only, however, when the science of chemistry had developed so that an accurate analysis could be made that we find mineral waters prepared scientifically. The therapeutical value of natural mineral waters has been recognized for centuries, but their use was practically confined to well-known spas, owing to the difficulty of transporting bulky material, and because natural waters lose their original virtues more or less when removed from their sources; therefore, artificial mineral waters were warmly welcomed. These waters when properly prepared have practically all the efficiency of those obtained from the natural springs, and they have the advantage of being of definite chemical composition, while the natural waters vary somewhat from time to time. The name soda water is a misnomer. Carbonated waters were originally made in England by the reaction of sulphuric acid on sodium bicarbonate, whereas all of our aerated waters are now made with the aid of marble or dolomite and sulphuric acid.

Without doubt Americans are the largest consumers of aerated and mineral waters in the world, and the number of these beverages is very great, including as it does ginger ale, root beer, etc. Such waters are very far from being confined to medical use and the ubiquitous siphon is found in the smallest village as an article of daily necessity. Where the water supply is questionable, carbonated waters, when scientifically prepared, are most valuable. The recent outbreak of typhoid fever at Ithaca is an example of what a serious matter the contamination of water really is. Unfortunately competition in the production of siphon water is very keen and in many cases the water is carbonated without being distilled, and put up under unhygienic conditions and, in fact, the Board of Health of the city of New York was compelled, a few years ago, to pass stringent ordnances regulating this business. Purity and accuracy are the two things which the manufacturer must keep constantly in view, and in the plant which we have selected for illustration, that of Carl H. Schultz, of New York city, every safeguard is employed to prevent the slightest contamination. All of the water used is distilled and is taken from the city mains. It is first conducted through coke filters which remove all suspended matters. It is then pumped into boiling tanks on the top floor of one of the buildings. Here it is boiled with the aid of steam coils and the volatile organic matter is thus driven off, the boiling being conducted under a slight vacuum, which is necessary to remove the steam. The water falls down by gravity into the feed boxes which are constructed to maintain a constant level of water in the stills. The stills are eight in number, the total capacity being 20,000 gallons per day, and are arranged in four sets of two each. They are constructed of heavy copper and are thoroughly tinned inside. They are surmounted with a dome and separator to prevent any solid particles from being carried over with the steam. The stills are provided with water and steam gages, two hand-holes on each side for cleaning, and two glass peepholes on opposite sides on the top. In front of one of these holes a gas jet is kept burning, which lights up the inside so that the operation can be watched. The condensation of the steam takes place in tall, vertical cylinders containing a large number of small pipes through which cooling water is pumped. A large amount of cooling effect is obtained indirectly from river water, and to guard against even the remotest chance of contamination which would result from the river water coming in contact with the distilled water by reason of any unseen defect in piping, the river water is pumped to the top of the building and is allowed to flow over coils containing only Croton water, which is run through the condensers. This hot water is then cooled down for use again in the condensers. Distillation is accomplished by steam supplied by two large boilers. There are no coils in the stills, but the steam is conducted into what are termed "lenses," which resemble a double-convex lens. This steam, which is still very hot when it leaves the still, is conducted to the top floor and used for preheating the water before distillation, thereby utilizing all the heat. The hot distilled water after leaving the condensers passes down through



Cooling Croton Water for Condensing, with Sea Water.

a series of heat exchangers, where it is cooled down as much as possible by the filtered Croton water, and then through a second set of heat exchangers, where it is cooled down to about 40 deg. by cold water from the refrigerating machine. It is then stored in large covered tanks provided with cotton plug vents to prevent any contamination from the air, the water being kept at a temperature below the germinating point of bacteria. All of the pipes are either lined with block tin or are silverplated on the inside, and all of the fittings are also silverplated, for distilled water acts more powerfully on metals than does ordinary water. The water is now run into large demijohns for the use of those who care for a water which is not aerated; or it flows by gravity to the carbonating machines.

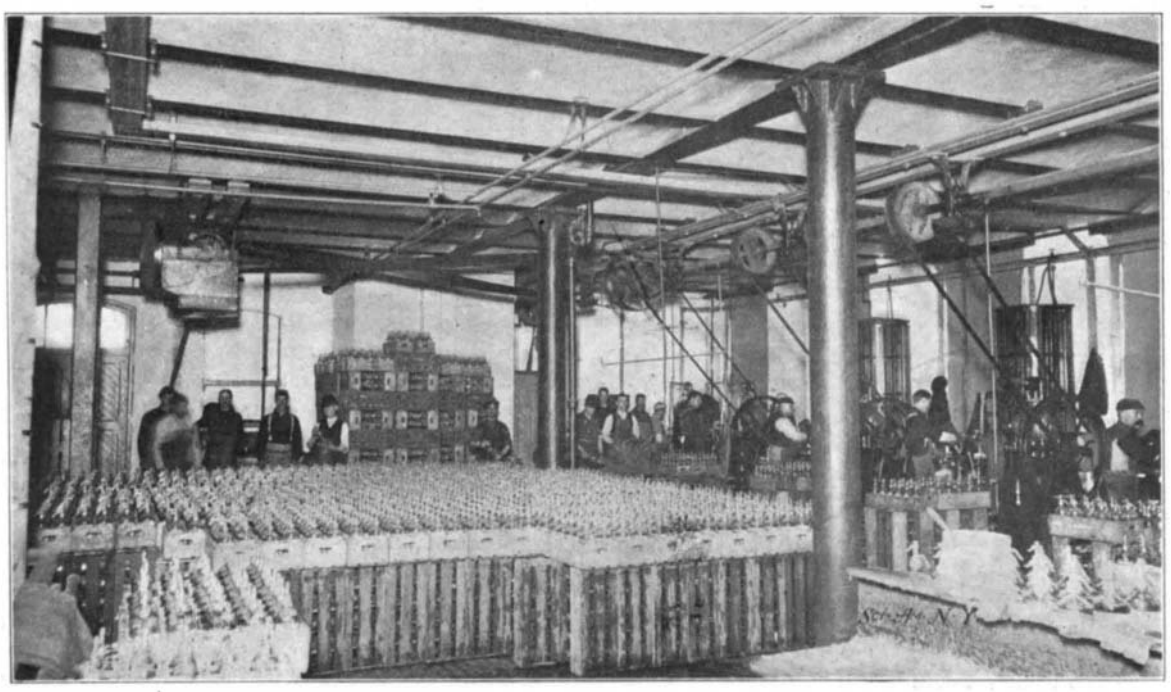
Siphon Filler.

The carbonic acid gas employed in charging the waters is produced by the action of sulphuric acid upon dolomite, which is calcium magnesium carbonate containing 54.35 per cent of calcium carbonate and 45.65 per cent of magnesium carbonate. It is ground and placed in cylindrical generators constructed of copper. The acid flows from lead-lined iron reservoirs placed in proximity. The ground dolomite is poured into the generators through a hand-hole, which is then closed. The water and acid are added and the contents are constantly kept in motion by an agitator which resembles a paddle. This is kept in motion by means of power, its shaft passing through the end and having a pulley attached to it. The evolution of the carbon dioxide gas is rapid. After a thorough purification the gas is stored in gasometers, from which it is drawn to the various carbonating machines.

In a spacious working laboratory are prepared the solutions which are used in making the various mineral waters. They are compounded with the greatest care, every precaution being used to secure results which shall be scientifically accurate. The analyses followed in the compounding of these waters are the recognized standard analyses of the natural spas and were made by such men as Strure, Bauer, Liebig, etc. All of the salts are analyzed for purity, and the finished product is subjected to a constant scrutiny in a splendidly equipped laboratory, the water being tested for each thousand siphons. The solutions are sent to the filling department and are introduced into large graduated vessels which are filled up to the mark with cold distilled water and thoroughly mixed with a stream of carbonic acid gas. Two samples are then taken, one from the top and one from the bottom, and sent to the laboratory for examination, no siphon or bottle being filled until the samples have been approved.

Mineral waters are bottled with the aid of special machinery. The bottles are thoroughly washed and then rinsed by reservoir rinsers. The filling machines are provided with valves and means for compressing and inserting the cork. The charged water is pumped into a reservoir at the top of the machine and from there it flows under pressure to the bottling machine which both fills and corks. In the case of club soda the bottle is seized by a pair of peculiarly shaped tongs which serve to hold the cork in position until it can be wired. The neck of the club soda bottle is not straight, but conical, so that the cork is expelled immediately on unwiring. The pumps have water lubrication, as it is not permissible to allow any aerated water to come in contact with grease.

The siphon is the most convenient means of dispensing carbonic or mineral waters. While quite an old invention, slight improvements are made from time to time. They consist of glass bottles to which a metal head, forming a draft tube, is attached. They are filled at a pressure of 120 pounds and the mechanism of the head is so arranged that when the lever is depressed the valve is opened and the liquid flows out by its internal pressure through a glass tube which extends nearly to the bottom. The valve is kept normally closed by a spring. In the plant which we illustrate the siphons are made on the premises, with the exception of the glass bottles, which are imported from Bohemia. The first step in the manufacture of siphons is to test the bottle. This is done by first heating the bottle filled with water to a temperature of 98 deg. The bottle is then placed in a carrier provided with a wire net. Temporary testing heads are screwed down on to the bottles, and they are then subjected to hydrostatic pressure of 350 pounds to the square inch, and the carrier is swung into a tank containing ice water. If the bottle stands the test without breaking, it is considered that it was perfectly annealed and safe to send out. The siphon head is now attached and the name of the maker is etched upon the glass with the aid of a sand blast. The internal working parts of the siphon head are silverplated, including the spring, in the electro-plating plant on the premises. The siphon head is of a composition and is kept bright by being buffed each time it is returned to the factory.



Siphon Filling Rooms.—Total Capacity, 20,000 Siphons Per Day.

MANUFACTURE OF CARBONATED MINERAL WATERS.

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Special machines are used to fill the siphons. The siphon is inverted and placed at an angle in a forked rest. The lever is depressed as the valve is opened to allow of the influx of water which is being forced in by an adjacent pump. After filling the siphons and labeling them they are placed in a box ready for shipment to customers. Some idea of the magnitude of the mineral water business may be obtained when it is stated that this plant has a capacity for filling 50,000 siphons per day, and it requires 52 wagons to take them to their destination. We are indebted to A. P. Hallock, Ph.D., for courtesies in the preparation of this article.

Death of Dr. John E. Watkins.

The United States National Museum feels keenly the loss it incurred by the sudden death in New York city, August 11, of Dr. John Elfreth Watkins, who for many years was curator of mechanical technology.

Dr. Watkins received his academic education at Tremont Seminary in Norristown, Pa., and then entered Lafayette College, Easton, Pa., where he was graduated in the scientific course in 1871, taking the degrees of C. E. and M. S. For a year after graduation he served the Delaware and Hudson Canal Company as mining engineer, and then entered the employ of the Pennsylvania Railroad as assistant engineer of construction, being stationed at Meadows Shops, N. J., where he remained until 1873. On his recovery he was assigned to the Amboy division of the Pennsylvania road and served in various capacities during the ten years that followed. In 1873 he was appointed chief clerk of the Camden and Atlantic Railroad, and a year later was assigned to a similar office on the Amboy division of the Pennsylvania Railroad, which place he then held until 1886.

Meanwhile, having become interested in studying the history of the beginnings of mechanical arts in the United States, he was brought into close relations with the late Dr. G. Brown Goode, upon whose recommendation the then secretary of the Smithsonian Institution, recognizing his worth, invited him to become honorary curator of transportation in the National Museum, which place he accepted in 1884, and at once began to develop that part of the museum's collections which are now so valuable. Two years later he severed his connection entirely with the Pennsylvania road, in order to devote all of his time to the museum, and continued as curator until 1892.

Around the World in Fifty-Four Days.

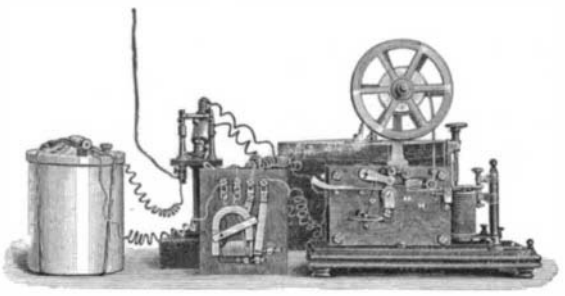
Jules Verne once wrote a story in which he described the adventures of a certain Mr. Phineas Fogg who, after many harrowing incidents, succeeded in traveling around the world in eighty days. On July 2 of this year, Henry Frederick left New York on the steamer "Deutschland." He returned at midnight August 26, after having completely encircled the earth in fifty-four days, seven hours and twenty minutes. To be sure, Mr. Frederick had one facility unknown at the time Jules Verne's story was writen, and that was the Siberian railway. Eighteen days were passed on the train from Paris to Dalny, China; two more were occupied in crossing the Yellow Sea. Japan was traversed in another two days. At Yokohama, Mr. Frederick missed a steamer by ten hours. That cost him seven days, for he was compelled to take a slow boat two days later, which spent sixteen days in crossing the Pacific. Landing at Victoria, he made the trip across North America in somewhat more than four days. In all that time the traveler slept in but one hotel, and that was in Yokohama.

A Georgia mail carrier has invented an electric whip which, according to Machinery, presents considerable novelty. The mail carrier drives a wagon with doors that could be closed in rain. In stormy weather he naturally disliked to open one of the doors in order to reach out and apply the lash to his horse, which, being an intelligent animal, naturally took advantage of this situation and always lagged in rainy weather. To overcome this propensity the Georgia Edison attached a pair of copper plates under the harness saddle and connected them by a wire to a hand-operated dynamo in the wagon. When the steed began to jog up and down, without making much advance, it was time to turn the dynamo crank, which gave the horse a very evident wish to get over the ground more rapidly, and almost any desired speed could be obtained, according to the number of rotations per minute given the dynamo armature. An apparatus is now contemplated, says the Atlanta Constitution, which paper has the distinction of first telling about this invention, for use on plows, whereby both the mule and plow hand shall be automatically shocked every few minutes. It is believed that such an attachment would find a tremendous sale all over the South, as by its use farmers could be very sure that no darkey would go to sleep between the plow handles.

GUARINI'S WIRELESS FIRE ALARM APPARATUS.

At Brussels on the 26th of July last, Emile Guarini carried out some practical experiments with a fire alarm device invented by himself, which possesses the peculiar characteristics of notifying the engine houses automatically without the intervention of a central station, not only of the existence of a fire, but also of the name of and position of the building in danger of destruction. The tests which he made took place in his laboratory. They were only the prelude to the series of experiments which he is about to undertake with the city for his field and the engine and truck houses for receiving stations.

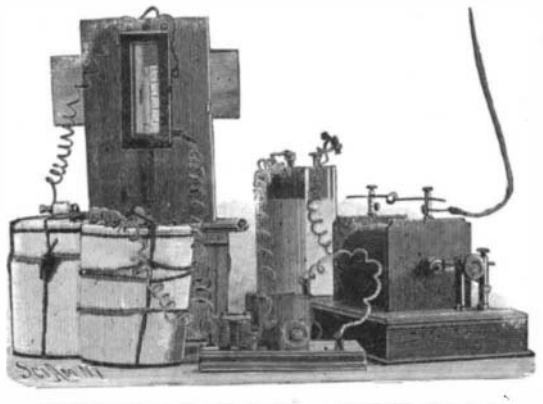
In one corner of his workshop was placed a structure representing the building in danger, which structure was fired. The fire was contained in a small brazier. Removed to the farthest extremity of the laboratory were the engine houses, or what represented them, provided with means of receiving notice of a fire. These



RECEIVER OF THE WIRELESS FIRE ALARM.

means consisted of a wireless telegraphic receiver with its accompanying antenna. Of Mr. Guarini's device the essential feature is a thermometer which is so arranged that it is capable of releasing a toothed wheel which serves to transmit the requisite information. When the flames, or perhaps better said, the heat therefrom, reach the thermometer the mercury naturally rises in the tube, and upon reaching the mark indicated by 42 deg. on the Réaumur scale it touches a small platinum wire inserted in the upper end of the tube and thereby closes an electric circuit including an electro-magnet. Thus excited the magnet attracts and holds its armature. This motion releases a toothed wheel which, by means of a weight or spring, is made to revolve, and, during each revolution, produces a series of makes and breaks upon a contact piece placed in its path. It may be well to state just here that this toothed wheel is not an ordinary gear wheel with teeth cut at regular intervals, but a wheel of peculiar construction, having irregular indentations, providing thereby irregular teeth or projections which, coming in touch with an electric switch or contact piece, are capable of making repeated connections and holding them for varying intervals, by which means an unlimited diversity of signals may be sent over the line and made intelligible at the receiving end. An induction coil is connected with this, and, being periodically excited by the electrical impulses induced by the toothed wheel, transmits, with the aid of its antenna, the necessary message, which in this case describes the exact location of the endangered property to the neighboring engine houses.

At the engine house, again, another antenna collects



TRANSMITTER OF THE WIRELESS ALARM.

the electrical impulses, excites in its turn a coherer, a battery is cut in, the current flows through, and starts a Morse apparatus which registers the message, while an electric gong calls the attention of the attendants to the signal received. The receiver also has a visible sign in the shape of an incandescent lamp, which glows when the alarm is sounded. The apparatus is tolerably simple, still it seems to be very complete, and to have been well studied out as to its details. Mr. Guarini states that the idea which he has elaborated and put into practical shape emanated from a certain Signor Mollo, a fire chief of the city of Naples.

To avoid calling out the force unnecessarily the transmitter is provided with an audible annunciator situated and operating in the building attacked by the fire. If the occupants, thus apprised of the danger, think they can successfully cope with the fire without the assistance of the fire department, they may easily break the connection and interrupt the transmission of the predetermined signal. Should the firemen have started, however, they will be notified on the way. For this purpose it is only needful to provide the engines or trucks with a receiver such as is employed by Marconi and attached to the war automobiles. The whole thing is feasible because such vehicles easily lend themselves to other uses.

Effect of Radium Rays Upon Frog Larvæ.

As the radium rays have been found to attack animal tissue and different organisms, causing destruction of the tissue and even death of various specimens, M. Georges Bohn thought it would be of interest to see whether a greater or less exposure to the rays would have an influence upon tissues in formation or upon animals in course of development. Among other specimens 80 larvæ of toads (*Bufo vulgaris*) and of frogs were exposed successively to the influence of the rays. They were placed for three to six hours in a shallow tank containing a thin layer of water upon which floated a tube with a small quantity of bromide of radium. The action of the rays on the specimens is strongly marked and brought out the following results, a certain number of free specimens being used for comparison. In the case of the toad's larvæ, normally the growth is very slow in the first ten days after hatching. He finds that 18 embryos, after exposure to the radium, undergo a diminution in their growth. The action is more strongly marked with frogs' larvæ. In the case of the embryos, the normal growth is more rapid than in the preceding. The embryos, which are still inert after hatching, rapidly acquire a caudal membrane and the gill-like appendages. Then on the eighth day the appendages are lost and the embryos become transformed into tadpoles. He used 38 embryos of different ages from 1 up to 8 days. Of these 9 died almost at once on exposure to the rays. For the remainder there are two cases. First, on the individuals of 8 days' growth the radium has an immediate action. The appendages disappear and the skin swells up in some places and becomes wrinkled, thus producing deformed specimens. Second, with younger specimens the rays do not have an immediate action, but regardless of the age of the larva when it is first exposed, the same kind of deformities are produced in a constant manner the moment it becomes transformed to a tadpole. The 29 deformed specimens which he obtained differed but little from each other. The younger the individual at the time of applying the rays, the smaller is the development of the tail, and the stopping of its growth acts upon the natatory membrane which normally is developed in the first few days. In all cases there is a shrinkage in the rear of the head and here the skin is wrinkled to a great degree. Some of these specimens live for 10 days. In the case of tadpoles exposed to the rays, while normally their growth is slow and progressive, 19 specimens underwent a diminution in growth. In these experiments it is clear that the rays act especially upon the growth of tissues and organisms, and when this is slow they cause a diminution in size, as with the tadpoles, or when rapid and accompanied by transformations (as with the frogs' embryos) they destroy the tissues and retard the growth or in other cases accelerate it, and this according to the region and the nature of tissues. A fact is brought out which is most interesting and bears upon one of the most fascinating problems of biology. The passage of the rays through the body of an animal for a few hours causes the tissues to acquire new properties, which remain in the latent state for long periods and then are manifested suddenly at the moment when the activity of the tissues increases normally.

The Current Supplement.

A most striking illustration, showing how a single-crown wooden face was attached to a four-crown cast-iron 55-ton engine-pulley, forms the subject of the front page of the current Supplement, No. 1444. Dr. J. W. Wainwright gives many an interesting historical bit of information about the apothecary. An ingenious portable electrical drill is described, the text being accompanied with several striking pictures. The Labyrinth of Crete has been made the subject of some very valuable archæological investigations, which are recorded in the Supplement in a well-written account. Some months ago mention was made in these columns of a new process of seasoning or vulcanizing timber invented by W. Powell, of Liverpool. The process is very fully described in the current Supplement. How the United States Geological Survey measures the velocity in river channels is told by H. A. Pressey, both by words and pictures. Sir William Ramsey and Mr. Frederick Soddy recount some new experiments in radio-activity and the production of helium from radium. Prof. Vivian B. Lewes, who is one of the foremost living authorities on gas illumination, treats of the future of coal-gas. "Fuels Other than Coal and Wood" is the title of a suggestive article.

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HOW THE EARTH'S MOVEMENTS ARE NOTED.

The land on which we live and build our houses—the land, which the sea-writers of the early part of last century confidently and almost affectionately termed *terra firma*—is well nigh restless as the ocean which washes its shores. In England at least seventy unfelt earthquakes, each of which has a duration varying from twenty minutes to several hours, may be recorded yearly. Our buildings rock and sway, if we could but see them, as the masts of a ship on a heaving sea. To be sure, the incessant rising and falling of the waters is more violent than the motion of the land. But the difference between the two is largely a difference of effect—the difference between a billow and a ripple.

We, who live far north of the equator, never perceive the feeble tremors of the earth beneath our feet. But the man who spends his life in studying the movements of the land, great and small—seismologist he calls himself—knows better.

The seismologist knows that the earth throbs, not because he has better eyes than other people, but because he has devised wonderfully ingenious instruments, so highly sensitive that they tremble as the earth trembles, and thus enable him, as it were, to feel the earth's pulse. And with the help of these delicate instruments, he can tell us how large, or rather how small, are the ripples that play over the earth's surface. Some day when more seismological stations are established throughout the world, when more seismological records have been gathered, and when some master mind will burst forth whose grasp is so broad that it can embrace many isolated scientific facts that now apparently have no connection, we may even know what earthquakes really are and by what they are caused. When that scientific millennium comes, the earthquake-prophet will appear in the land and tell us when and where we may expect the next volcanic eruption or upheaval of the earth.

It must be confessed that the theories of the origin of volcanic eruptions and of earthquakes, with which science has so far furnished us, are more picturesque than useful. About one hundred and fifty years ago a Cambridge professor, John Michell, advanced the remarkable theory that the earth's crust constituted but a shell, the interior of which was a liquid body. He thought that this interior liquid was in some inexplicable way lashed into waves, just as a carpet becomes a billowy mass when shaken by one corner; and that such waves shook the earth's crust and produced earthquakes. For a century and more that theory, modified slightly to suit newly-discovered facts, has been paraded in every school and college that professed to teach anything at all of geology. Modern physicists, however, have contumeliously knocked Michell's theory on the head. We are almost ashamed now that we ever believed it. With the fate of Michell's doctrine before them, scientists have been loath to advance new ideas. Nevertheless, an English geologist of note had the courage to believe that earthquakes were due to "the snap and jar occasioned by the sudden and violent rupture of solid rock masses, and perhaps the instantaneous injection into them of intumescent molten matter from beneath." That seems bewildering enough to be true. But the "intumescent molten matter" theory has also been laid at rest. Well aware of the enormous expansive force of steam, some students of earthquakes, have not hesitated to attribute such violent eruptions as we have recently witnessed in Martinique, to water which has found its way down into the earth and come into contact with highly heated masses of rock. The theory is at least plausible. But it has been sharply assailed by well-informed critics.

After all this indiscriminate theorizing, it must be confessed that but little progress has been made in furnishing an adequate explanation of the origin of earthquakes and volcanic disturbances. Seismologists have succeeded in establishing simply the fact that the occasional displacements of the earth's crust are due to the sliding, crumpling, bending, and cracking of rocks. The origin of such a disturbance may be best described as a wrench, which, when analyzed, is found to consist of a pull and a twist. This wrench both compresses and distorts. It gives rise to two waves—a wave of compression and a wave of distortion—which travel with different velocities. Rock, like most bodies, tends to return to its original volume, after compression, by virtue of its elasticity. To the forcing together and springing apart of the rock molecules is due a wave of longitudinal displacements—one of the two waves mentioned. The rigidity of the rock gives rise to a wave of transverse displacement—the other of the two waves.

If an earthquake be simply the result of wave motion, an inquiring man might ask: How comes it that only certain places experience the shock, and not all those along the line of the wave.

A distinction must be drawn between the movement of the wave and the movement of the molecules of rock through which the wave travels. The pulse of the wave may be propagated to a vast distance; and yet the excursions of the rock molecules are confined within narrow bounds. Imagine a long row of marbles, placed on a table, the one touching the other. If a shock be imparted to the marble at one end of the row, the marble at the opposite end will leap out of its place; but the intermediate marbles will scarcely move at all. The wave was transmitted through its entire row, but only where it broke, was the shock felt. Thus is the shore battered by sea-waves; thus is the earth heated by the breaking of light-waves sent by the sun; and thus it happens that such rock-molecules during an earthquake may move only through a few inches, while the undulation may travel for hundreds of miles. The distance through which the individual molecules oscillate is called the "amplitude" of the wave.

With the effect of a seismical wrench determined, the next step is to invent some means of detecting and recording the waves, felt and unfelt, to which that wrench gives rise. Such means are primarily of importance for the purpose of determining the path of the wave. Naturally, the waves that can be felt are those most easily recorded. Every object that has been visibly affected by a seismic disturbance is a recorder, to a certain extent. Fractures and fissures in walls rent by an earthquake are of inestimable value to the seismologist, because they often indicate the direction in which the waves emerge at the surface and the manner in which they break. The simplest of all recorders, one which has been used in Japan for over twelve hundred years, is a lamp, which, when overthrown, is extinguished. Still another form of recorder, simple as it is rude, consists of a vessel containing some syrup-like liquid, which rocks as the earth rocks, and leaves its mark—a rough indication of the direction and extent of seismic motion. A device much used in Italy comprises a tray, formed in its sides with recesses which are filled to the brim with mercury. When the earth trembles, the mercury is spilled into small cups, hung beneath the recesses. By measuring the amount of mercury retained by the cups, the intensity of the shock can be roughly gaged.

Such recorders are too crude for the modern scientist; they can never reveal those finer perturbations, which play so important a part in the study of earthquakes. For that reason the seismologist has been compelled to devise ingenious self-registering instruments which furnish us with permanent records of tremors, so exceedingly feeble in their effects that the particles of earth-molecules are not displaced more than a very small fraction of an inch in the transmission of the pulse.

The instruments in question are called seismoscopes and seismographs, and may be roughly divided into two classes. In the one class, the earth's motion is translated into diagrams written on stationary plates; and from these diagrams it is possible to ascertain with wonderful accuracy the extent and the direction of the principal vibration in a shock. In the other class, the movement of the earth is recorded on a surface traveling at a known rate; and from the tracing thus made the seismologist can deduce the period or the rapidity with which the earth's undulations follow one another. These latter diagrams are of extreme importance. They are the means of calculating the acceleration or suddenness of movements; in the hands of the engineer they are factors that enable him to erect structures capable of resisting known forces, and not structures simply strong enough to withstand an earthquake. To the man who knows an earthquake merely as a destroyer of towns, the diagrams written by the earth seem a tangled, hieroglyphic script. To the seismologist, they are as unmistakable in their meaning as printed words; they are autographs, as it were, written by the quivering earth at a time of great, internal violence.

In order to obtain a complete record of every detail of a seismic disturbance, the movement of the earth, in one of the most approved forms of instrument, is resolved into three components, the one vertical, the other two horizontal, and all at right angles to each other. These three component movements are registered by three distinct pointers on a sheet of smoked glass, which is made to rotate at constant speed by clockwork. A single earthquake always consists of many successive displacements of the ground; hence the mark traced by each pointer on the moving plate is a line comprising many undulations, usually very irregular in character. The amplitude, period, and form of each of these tracings are measured; and by compounding the three the seismologist obtains full information of the direction, extent, velocity, and rate of acceleration of the movement at any epoch in the disturbance.

Instead of using a smoked disk of glass, a drum can be employed, the record being made on a band of smoked paper. The diagram is less difficult to interpret than that of a plate, because it is written on either side of a straight line, and not around a circle. In order to avoid the trouble of handling smoked paper, the diagram is sometimes written along a straight line with a pen or pencil. When the shock has passed, the drum stops. But if a second or third shock should occur, which is often the case, the drum is again automatically set in motion.

In order to record slight earth tremors, an instrument called a tronometer is used. Every five minutes, by clockwork contacts and an induction coil, sparks are discharged from the end of a long pointer, and perforate bands of paper. If the pointer be at rest holes are pierced, following one another in a straight line; but if the pointer be in motion, the bands of paper are perforated in all directions. The earth movements which cause these so-called tremors are apparently long surface undulations of the earth's crust, resembling very much the swell of the ocean. A more satisfactory record of this swell is made by a continuous photograph of a ray of light reflected from a small mirror attached to an extremely light horizontal pendulum.

Electrical seismoscopes are among the most delicate devices yet invented for the measuring of earthquakes. They are of such construction that they cannot be here described for lack of space. So sensitive are they, that the slightest disturbance closes an electric circuit, thereby actuating electro-magnets and liberating the driving mechanism of the recording surfaces on which the earth's signature is written.

In some Japanese observatories the time of an earthquake is recorded by a curious form of clock. When the ground trembles, the dial moves quickly back and forth and receives on its surface three dots from ink pads on the hands. Thus the earth is made to stamp on the dial the exact hour, minute and second when it trembled.

The list of the instruments might be tediously multiplied. Enough have been mentioned, though, to show through what means our knowledge of the movements of the ground has been increased, and how we are investing earthquakes with a significance which they certainly did not possess for our forefathers.

Future Application for Radium.

The Anglo-Indian Review summarizes an interesting account of the possible future applications of radium. The area where success is practically assured is at present not very large, but in the medical field it is already fairly extensive. In the working of X-rays and in the marvelous results achieved in the treatment of cancer and blindness we have every hope for great and universally benefiting results. In its industrial application we are somewhat restricted by the extremely limited supply of radium available, but it is stated that a small fraction of an ounce, properly employed, would probably provide a good light sufficient for several rooms and would not require renewal during the present century. It has been calculated that the energy stored up in 1 gramme of radium is sufficient to raise 500 tons weight a mile high. An ounce would, therefore, suffice to drive a 50-horsepower motor car at the rate of 30 miles an hour round the world.

A Test With Radium to Restore Eyesight.

The New York Sun publishes an account of an experiment conducted by William J. Hammer and Dr. Amon Jenkins for the purpose of ascertaining the effect of radium rays on a blind girl. From the account published, it cannot be gleaned exactly what degree of success was attained. Still it would seem that some favorable results were obtained by the combined effect of an X-ray tube with radium. Some change in the patient has taken place; but just what that change is has not been given out.

It is said that London has no less than 313 parks and open spaces, while in 1884 their number was only 103. They are reckoned to have cost $10,995,000. On a rough calculation there is an acre to 752 persons, reckoning to London a little more than 4,500,000 souls. New York, on the other hand, has in the Borough of Manhattan public parks covering an area of 1,415 acres, in Richmond 2¾ acres, in Brooklyn 1,026 acres, in Queens 550 acres, and in the Bronx 3,866 acres, a total of about 6,862¼ acres. In the boroughs of Manhattan, Brooklyn, Queens, and the Bronx there are 321,561 feet of parkways, streets, avenues, etc., under the jurisdiction of the department. The vast playground for coming generations in the Bronx is made up principally by Bronx Park, 661 acres, against Central Park's 843 acres, Pelham Bay Park, 1,756 acres, and Van Cortlandt Park, 1,132 acres.

In "The Mineralogy of the Chicago Area" Prof. Crook, of the Northwestern University, states that diamonds are deposited between Chicago and Milwaukee. Some seventeen specimens, weighing together about 70 carats, have been found. The largest weighed 21¼ carats. They are commonly white or faintly green or yellow in color. They were found in the sand and gravel of the kettle moraines or in the beds of streams.

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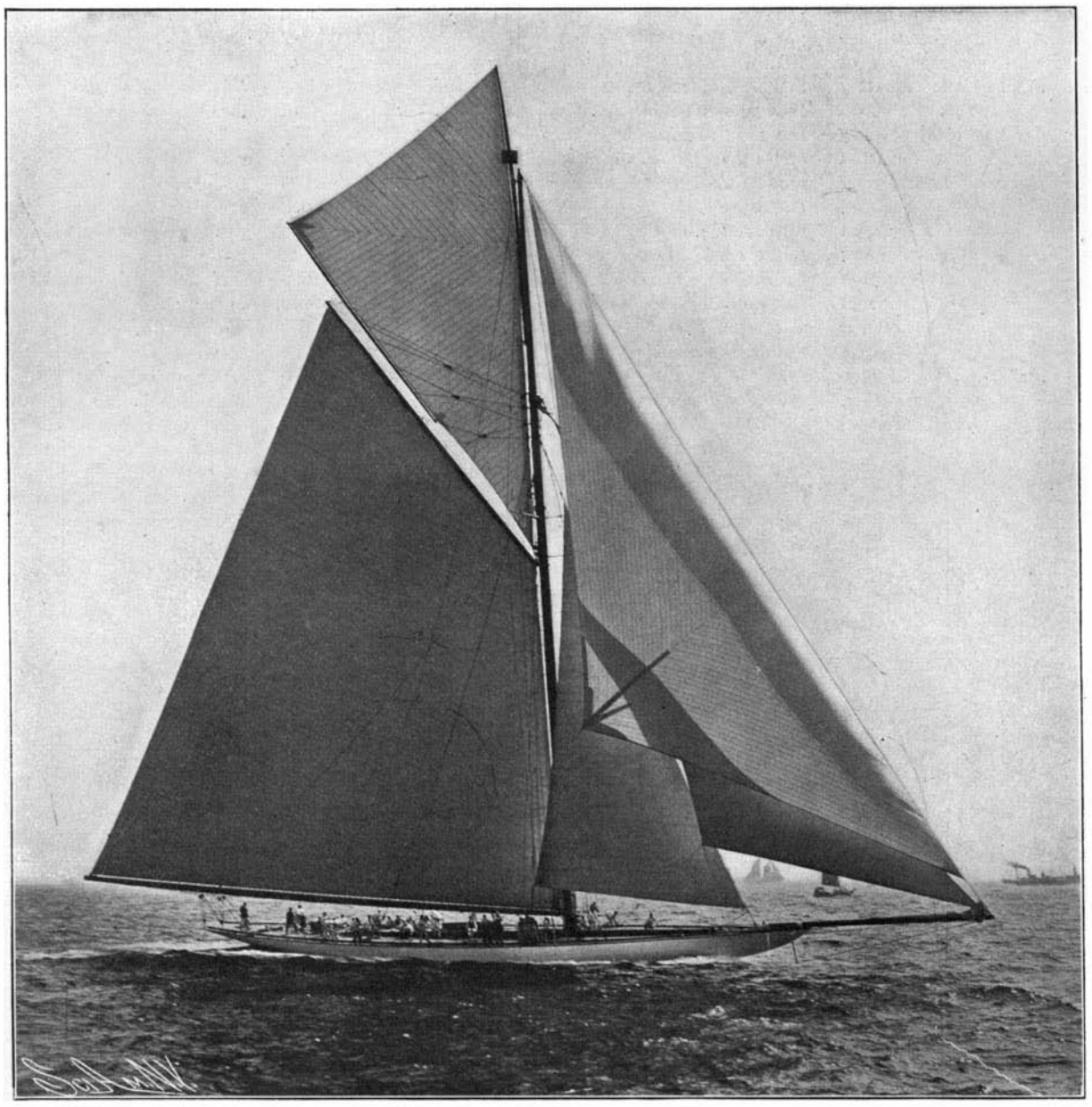
THE "SHAMROCK"-"RELIANCE" RACES OF 1903.

The two finished races and the two inconclusive attempts at a race which have already occurred in the contests this year for the America cup, have demonstrated that in average wind and weather "Reliance" is unquestionably the better boat under the conditions governing the America cup contest; and to say this is to say nothing disparaging of the challenging boat. "Shamrock III." is by far the best challenger that ever hoisted sail at Sandy Hook. She is a splendid boat of which both her designer and owner may well be proud, but in "Reliance," as we have shown elsewhere, she has met a type of yacht which by its peculiarities of form and overpowering spread of canvas is more than a match for her in any but certain specified conditions of wind and sea, which are rarely to be met with off Sandy Hook.

A remarkable feature of the present series of races is that both boats have proved to be weakest on those very points of sailing in which each was supposed to show to the best advantage against its opponent, and the curious thing is that this upsetting of expectations applies not merely to the general public, and to the yachting experts, but even to the designers themselves. Herreshoff believed that the full-water line and great overhangs of "Reliance," which increase her water line to 125 feet in a scupper breeze, would make her by far the fastest boat in reaching of the 90-foot class. At the same time it was feared that in light winds her work when close-hauled for the weather mark would be much below her general average on other points of sailing. It has turned out to be just the reverse, for in a whole-sail breeze "Shamrock III.," as was proved in the triangular race, was able to hold on very closely to her more powerful sister, while in going to windward in a light breeze "Reliance" has proved herself to be simply unbeatable. On the other hand it was expected by those who had "Shamrock" in charge that her best work would be in turning to windward in a light breeze, and that as the winds freshened her chances of defeating "Reliance" would proportionately diminish. As a matter of fact it has been just the reverse, the greatest gains by "Reliance" over "Shamrock" being made in light breezes to windward, and the most successful races for the challenger being those in which the winds were strongest. Evidently there are more things in sails and models



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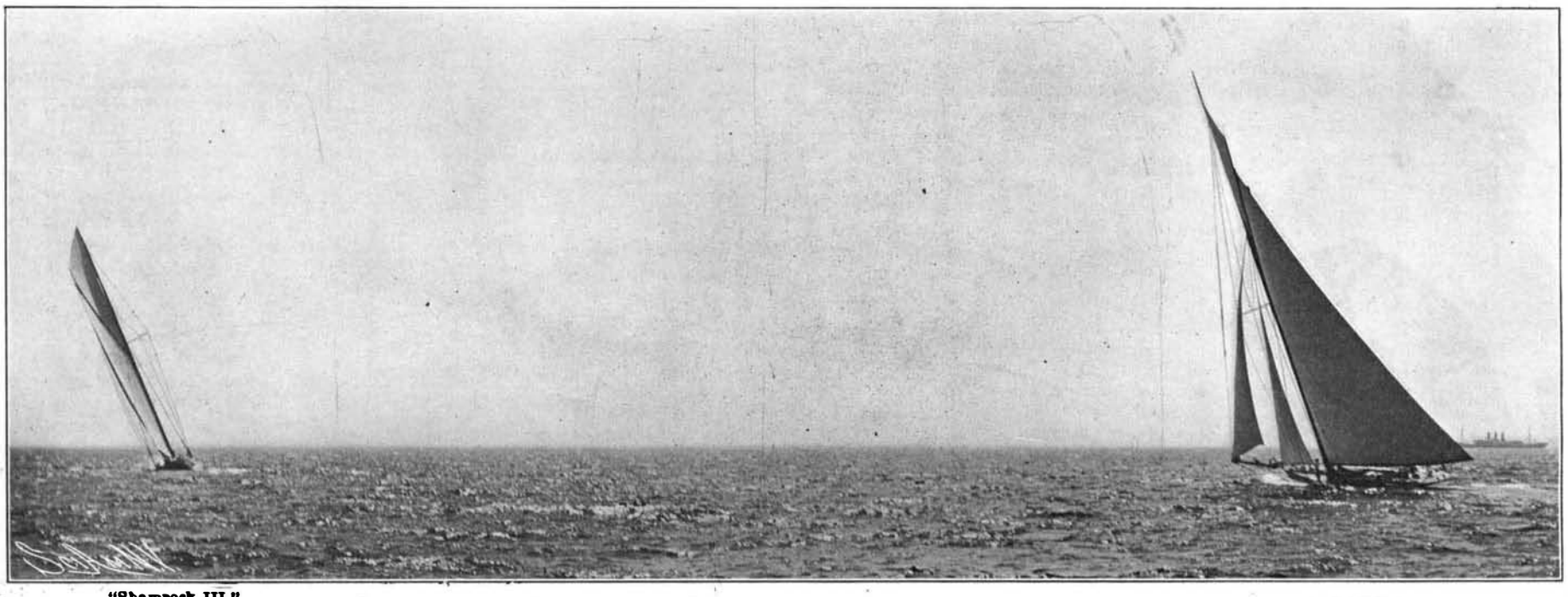
Shamrock III. Crossing the Line at the Finish, August 25. Reliance Won by 1 min., 19 sec.



"Shamrock III."
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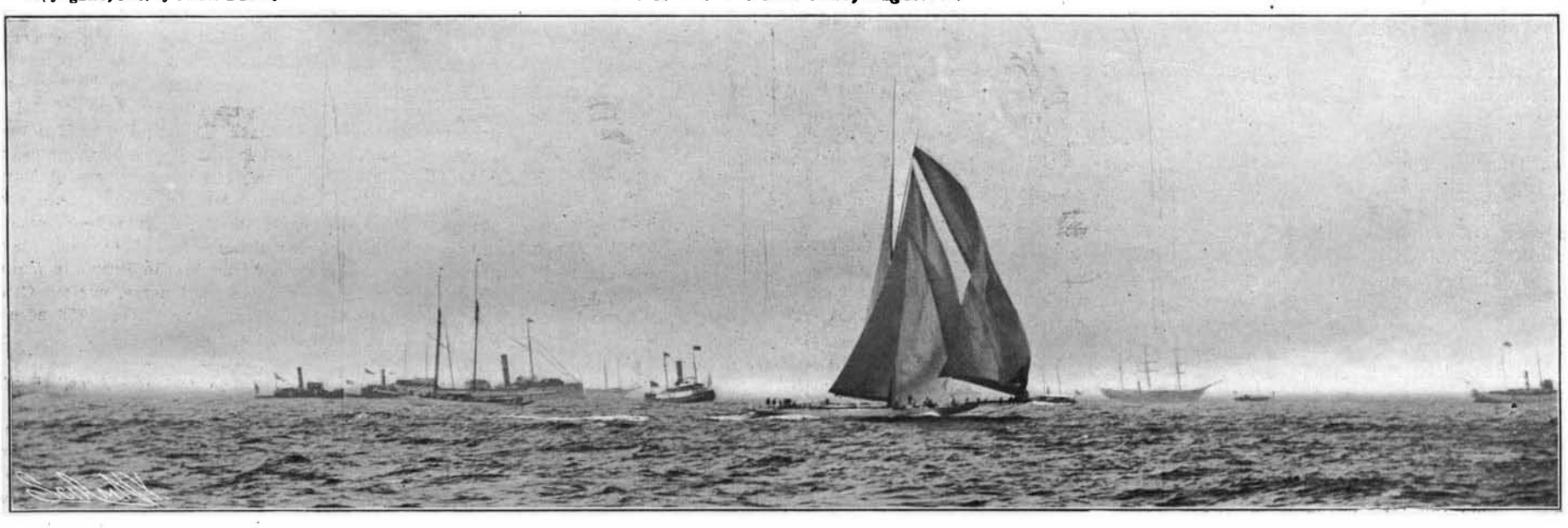
The Start of the First Race, August 22.

"Reliance."



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Finish, August 22. Reliance Winning by 7 min. 3 sec.

THE "SHAMROCK"-"RELIANCE" RACES OF 1903.

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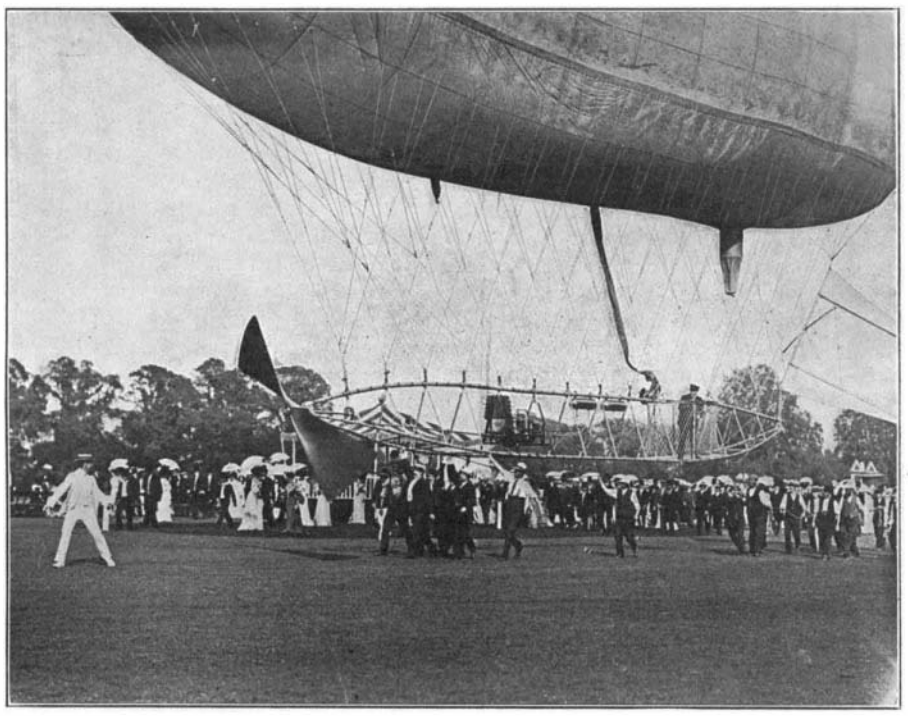
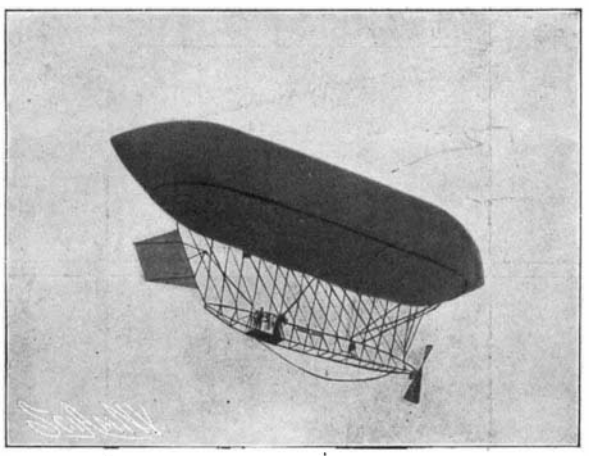
than are dreamed of in our philosophy. In the first finished race, sailed on August 22, over the windward and leeward course, the yachts started at opposite ends of the line, the "Shamrock" 4 seconds in the lead at the easterly end and "Reliance" crossing near the committee boat at the westerly end of the line. The wind was blowing steadily with a strength of from 10 to 15 knots and there was quite a little sea running which, as the event proved, came very near to the undoing of "Reliance" in the 15-mile beat to windward. As will be seen from the accompanying photograph of the start, both yachts were on the starboard tack, with the full length of the line separating them. It was well known that both boats were supposed to be at their very best in windward work, and it was felt that the first half hour's sailing would, barring accidents, determine the result of the race. "Reliance," with her extra sail spread, including her giant club topsail, of 2,300 square feet, was expected to have no difficulty in pulling away from "Shamrock" when running home under spinnakers, provided she could round the mark sufficiently far ahead to get a clear wind. On the other hand, if "Shamrock" should round the outer mark in the lead, or within a minute of "Reliance," it was believed that she might blanket the leading boat sufficiently to save her time allowance of 1 minute and 57 seconds. The yachts had not gone more than a mile on their way before it was seen that "Shamrock" was footing as fast and pointing considerably higher than "Reliance," the sweeter and rounder hull of the challenger taking more kindly to the seas than did the flatter and longer hull of "Reliance." Although neither boat could draw away from the other, "Shamrock" ate up steadily toward "Reliance" until her back wind (that is, the rebound of the wind from her sails) was bothering the American yacht, and, in order to avoid dropping into the wake of "Shamrock," "Reliance" was thrown sharply around on the port tack. Here occurred the first mistake—that is, according to American ideas of boat sailing—of the race, for, instead of coming around sharply on the weather quarter of "Reliance," "Shamrock" was kept on the starboard tack for two minutes before she came about, at which time the American boat had pulled out from her uncomfortable position. What was of greater importance was that "Reliance" was now about half a mile further to the westward, and when the invariable westering of the wind took place, which it did to the extent of a couple of points, "Reliance" was thereby placed a couple of minutes to windward, an advantage which she improved still further before she turned the mark, 3 minutes and 17 seconds in the lead. Between 5 and 6 minutes more was added to the lead of the American boat down the wind, and she finished a winner by the comfortable margin of 7 minutes and 3 seconds in a race which was sailed in the fastest time ever made over the windward and leeward course in the history of the America cup contest.

The second finished race was sailed over a 30-mile course of 10 miles to the leg. The wind varied in strength from 6 to as high as 15 knots in the stronger puffs, and the sea was considerably smoother than it was in the first race. The skipper of "Shamrock III." elected to avail himself of the full handicap, but by miscalculation he crossed 19 seconds later than the limit and was handicapped accordingly. In the beat to the outer mark the breeze freshened until the lee rails of the yacht were well awash, and in the smoother condition of the sea "Reliance" was not knocked off her caurse so badly as in the previous



Frame of the Airship, Showing the Motor, Tractor, and Propeller.

race and began to pull out slightly on the challenging boat. At the outer mark "Reliance" was 2 minutes and 32 seconds in the lead, having gained on the first leg of 10 miles 49 seconds in actual time. If we compare this with the gain of 3 minutes and 21 seconds in the 15-mile beat of Saturday's race, it will be evident how much the shift of the wind must have helped the leading boat on that occasion. On the second leg



The Airship in Flight.

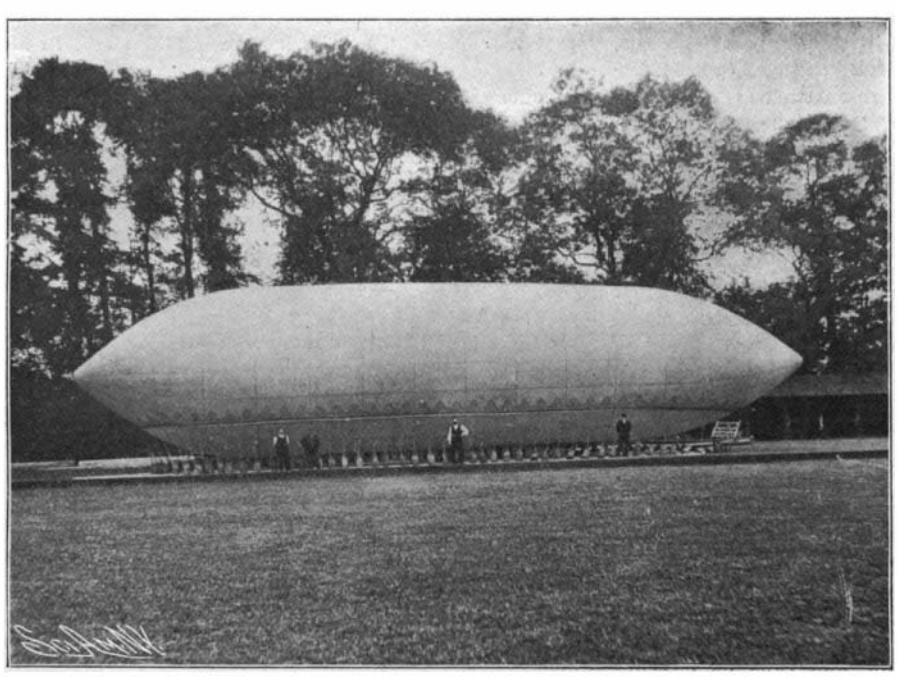
"Reliance" was expected to pull rapidly away from the English boat, chiefly because her easy lines and her great water-line length when heeled, should theoretically make her much faster on a reach than the shorter and deeper English boat. As it was, however, she only gained 1 minute and 23 seconds in the 10 miles of broad reaching. The last leg to the home mark was a close reach, and in the freshening wind the two boats made a magnificent marine spectacle as they rolled down until there was several feet of water on their decks. "Reliance" in particular presented a wonderful and striking marine picture. The water would roll over her lee bow, sweep in seething surges along her deck, and go boiling over the taffrail to add its white smother to that that came surging up from under her counter. On this leg she was carrying a little more canvas than she liked, having sent up at the start of the race when the breeze was lighter, her largest club topsail, whose sprit towers some 35 feet above her topmast truck. "Shamrock" appeared to be the stiffer boat at this angle of heel and carried a small jib topsail throughout the leg. She hung on doggedly to "Reliance," losing only 45 seconds on the 10-knot reach. At the close of the race the excitement was intense, as it became doubtful whether "Reliance" could save her time allowance of 1 minute and 57 seconds plus the difference between the two yachts at starting. This, however, she did and crossed the line with 1 minute and 19 seconds to spare. The race was one of the most picturesque and exciting that has ever been seen on the famous Sandy Hook course.

Two days later the yachts attempted to sail the third race which was expected to be final and conclusive. The wind was light and the sea perfectly smooth, conditions under which "Reliance" has done her very best work. Going over the line with a lead of nearly a minute the defending yacht both outpointed and outfooted the "Shamrock" and secured a commanding lead of 12 minutes and 31 seconds at the outer mark. On the run home the falling wind and head tide prevented the finish of the race, although "Reliance" was within 5 or 6 minutes of the line boat when the time limit expired.

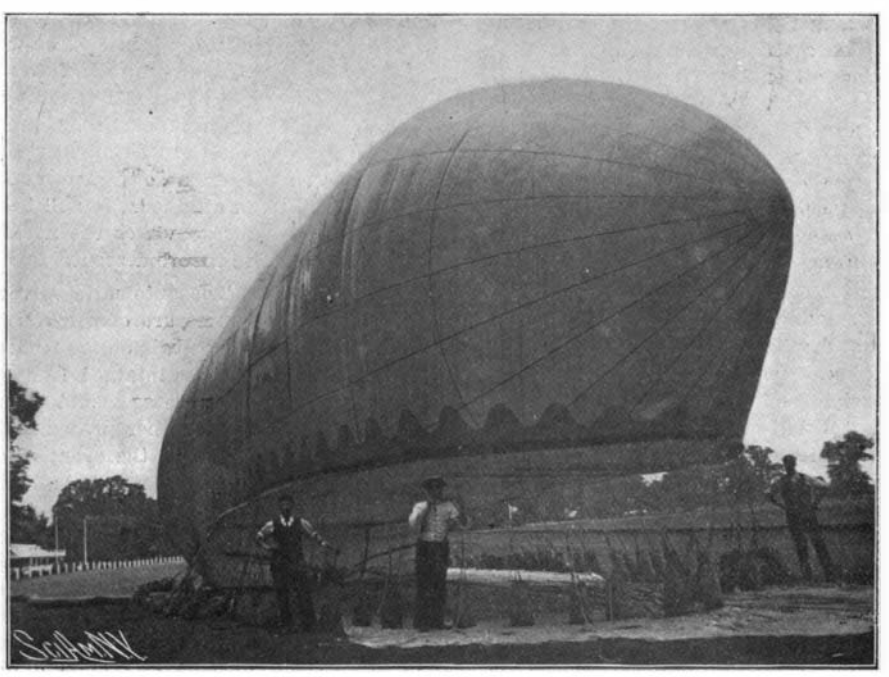
THE SPENCER AIRSHIP FOR 1903.

BY FREDERICK A. TALBOT.

The Spencer airship of 1903 is built on similar lines to that which proved so successful last year, with many improvements, which suggested themselves from time to time, during the experiments, embodied. It consists of the balloon or gas bag, with the deck or keel suspended below. The gas bag measures 87 feet in length from tip to tip, while its greatest diameter is 21 feet 9 inches, as compared with the 75 feet length by 20 feet diameter of the first vessel. It is in the same "fusiform" shape, to quote the inventors' description, which is the most suocessful design for a solid which it is desired to pass easily through a liquid. In this design the nose of the balloon is somewhat blunt, the contour of the vessel curving rather rapidly from the nose or bow of the balloon for a distance of one-third its entire length—29 feet—at which point is its maximum diameter of 21 feet 9 inches. The curve then decreases slightly during the next third of its length, at which point the diameter is 20 feet 3 inches; thence the taper is rather rapid during the last 29 feet to the end. From this design it will be seen that at no two points is the diameter of the gas vessel the same. The capacity of the balloon, which is made of varnished silk, is 24,000 cubic feet, which with coal gas will give it a lifting power of 960 pounds, while when inflated with pure hydrogen the lifting power will be 1,680



Broadside View of the Spencer Airship. The Gas-bag Gradually Tapers so that the Greatest Diameter is to be Found Near the End.



End View of the Airship, Showing the Belt from which the Framework Carrying the Deck is Suspended. The Gas-bag is Flat at the Bottom.

THE SPENCER AIRSHIP FOR 1903.

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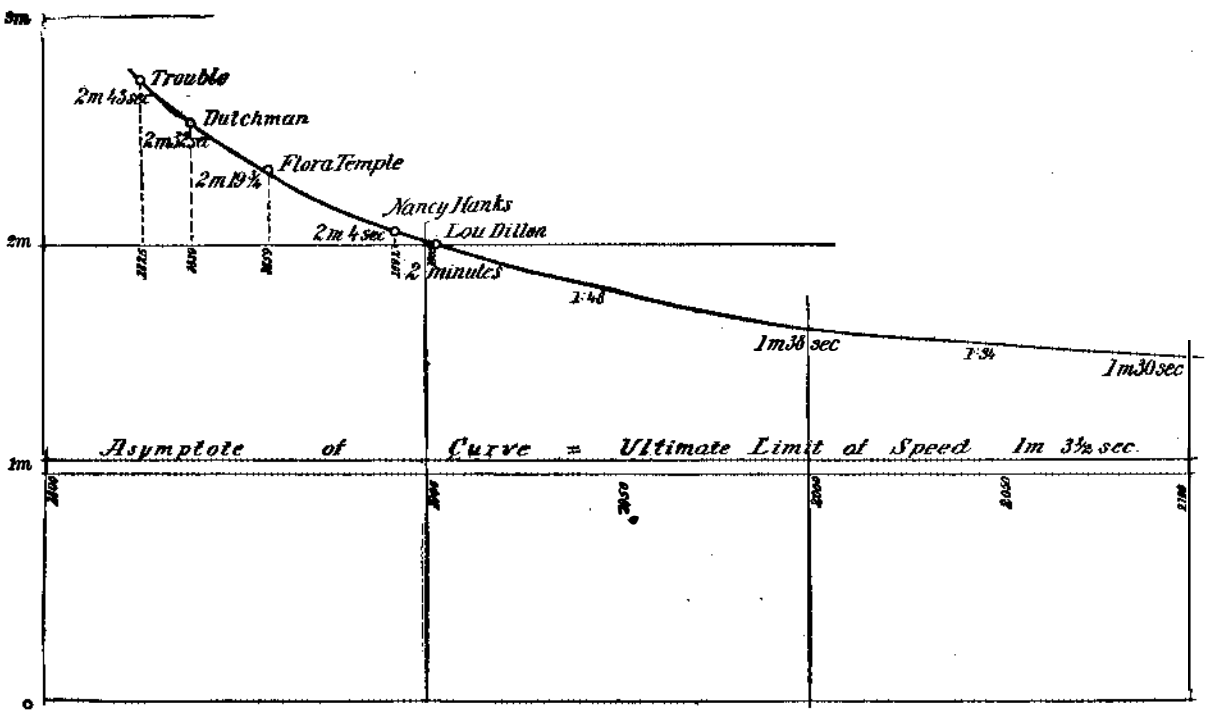
pounds. Beneath the balloon is suspended the car or keel. This is a framework structure of bamboo of the same design as employed in the first vessel. It is about 50 feet in length, and is constructed of three horizontal ribs arranged in the form of a triangle with the apex uppermost. The top rib has a slight downward curve from the center to the ends, the two lower ribs rising up a little to meet it at each extremity. The top rib has a vertical height of 4 feet 3 inches above the base, while at intervals of 3 feet 4 inches are placed cross struts to give strength and support to the ribs, and to insure rigidity to the whole structure. An end sectional view of the frame at one of these strengthening points has the shape of an isosceles triangle. The upper rib is built up of lengths of bamboo 3 inches in diameter, while the bamboo for the lower ribs is slightly thinner. The lengths are joined together by means of metal sockets, while the triangular bamboo struts, which are much thinner, are secured to the ribs by means of metal clips. At the point of the keel where the motor is placed the bamboo cross supports are replaced by angle steel frames in order to supply the necessary support to carry the engine.

Bamboo is employed for the keel, as it has been proved to be the most suitable for this purpose, owing to its combined lightness and strength. Ash and hickory, though very strong, are deficient in that lightness which is such a prominent characteristic of bamboo, and in the construction of a framework for such an airship as this, the maxim, "the minimum of weight with the maximum of strength," must be rigidly adhered to. On the other hand, pine, though sufficiently light if made thin enough, and strong, does not possess the flexibility and elasticity of bamboo. Aluminium or steel tubes might also be used, but owing to their liability to kink and buckle when brought end on into sudden contact with an obstacle, such as the ground, hedges, or the branches of trees, their utilization is not advisable. Bamboo is of such a springy nature, that it gives and takes with the shock, and so does not sustain any permanent injury.

At the bow of the vessel is placed the tractor or propeller which imparts the traveling motion to the craft. This innovation constitutes a prominent feature of the Spencer airship, which is *drawn* instead of being *forced* through the air. It is of the two-bladed form, with a total diameter of 12 feet, and a pitch of 15 feet. This tractor will make 300 revolutions per minute, and will just consume the power generated by the petrol motor, which is placed about 17 feet distant from the bow of the keel.



EQUILATERAL HYPERBOLA SHOWING THE LAW OF TROTTING IMPROVEMENT.

The petrol motor is of the four-cylinder type and is exactly the same as those employed for motor cars. It develops 24 brake horse power, and will have a thrust of 250 pounds. The petrol is carried in a small vessel placed above the water tank, the spirit gravitating therefrom to the carbureter. Sufficient petrol will be carried for five hours' journey, but this supply can be easily augmented if longer journeys are contemplated.

To avoid any possibility of the gas exuding from the balloon being ignited by any hydrogen flame issuing from the exhaust of the motor, the exhaust gases empty into a specially designed safety box of wire gauze. By this device there is no danger of any repetition of the lamentable disaster which befell Severo in Paris.

Amidships is placed a large water tank, which constitutes one of the novelties of this latest vessel. It is for the dual purpose of cooling the motor, to which the water is conducted through tubes, and also as ballast for lightening the airship to counteract the variations of temperature which are constantly altering the weight and buoyancy of the vessel. For ballasting, the water will be discharged from the tank until the minimum level is reached, this minimum level being that requisite for the cooling of the engine. The circulation of the water from the tank to the cylinder heads is maintained by means of a centrifugal pump, driven by the motor, as in the automobile. The tank has a capacity of 25 gallons of water, which is equivalent to approximately 250 pounds of ballast.

About 34 feet from the bow of the keel is the car which contains the aeronauts. It is oval in form, the top rail being made of bent ash, with a wicker-work platform upon which to stand, and rope lattice sides.

The rudder at the rear of the keel consists of a quadrilateral surface of balloon fabric stretched on a bamboo frame. Its dimensions are 15 feet by 20 feet. Two lines lead from it to the aeronauts' car, and it is easily and quickly manipulated in any manner desired by the aeronaut.

A further distinct improvement in this year's airship is the communication between the motor and all its driving parts from the car. This is carried out by Bowden wires, attached to levers placed in the car. By this means, perfect control is insured over the engine, the levers actuating and regulating, respectively, the sparking and the air mixture to the petrol. The ignition is the Simms-Bosch magneto-electric. The motor is started from the car, the lever for which communicates with the crank shaft, so that the engine may be started whenever desired, either on the ground before leaving, or after the balloon has ascended. This is a most valuable improvement since should the engine have to be stopped for any reason while the ship is in mid-air, it can be immediately and easily started again without necessitating return to the ground.

The balancing gear also communicates with the aeronaut in his car by means of the pendent trail or guide rope, and the upward and downward motion of the balloon can be altered at will. If the guide rope is drawn to the front of the keel, naturally the bow of the vessel will point downward in the direction of the earth, and will descend by the action of the tractor. If, on the other hand, the guide rope is drawn to the rear, then the front of the vessel rises and the tractor has a tendency to increase the altitude of the airship.

The inflator is also placed at the car and is in the form of a fan actuated by hand. By means of this contrivance the constant distension of the gas vessel is insured. In the event of a lower pressure causing the gas to contract inside the balloon, by bringing this pump into action air is forced into the balloon to replace the lost gas. The employment of this pump dispenses with the necessity of placing a ballonette within the gas bag, which principle has been adopted in some air vessels built on similar lines to the Spencer craft. The hand pump has the further advantage of enabling the aeronaut to vary the weight of the whole airship. Should the vessel continue to rise above the desired point, through the lifting energy of the gas, by pumping air into the balloon the gas can be displaced, escaping through the automatic valves, and so lessen the specific gravity of the whole, causing the vessel to be slightly heavier than the air and thus to exert a downward motion until the desired equilibrium is attained. It will be seen that this ingenious system also obviates the necessity of opening the main valve to insure descent.

The automatic valves are so made as to open when a pressure of gas equal to one-half the bursting point of the balloon is reached. A constant pressure is therefore maintained in the gas envelope, but not such a pressure as would cause the fabric to break.

A further precaution has been adopted by means of which in the event of the balloon bursting, the fall of the airship may be lessened in force. The keel or car is suspended from the balloon itself by means of a horizontal hempen webbing extending completely round the lower part of the gas bag. Consequently, should the balloon burst either below or above the line at which this horizontal webbing is attached to the fabric of the envelope, the remains of the silk would float upward and form a parachute, and thus by offering sufficient resistance to the air, prevent a too rapid descent, and avert a disaster which otherwise would be inevitable.

The tractor is driven by spur gearing. The crank shaft from the motor to the bow of the keel, is supported upon adequate bearings. The pinion at the end of this propeller shaft meshes in a spur wheel. As the motor is balanced to 1,500 revolutions per minute, and it is only desired to drive the tractor at 300 revolutions per minute at full speed, a ratio of 5 to 1 drop is made; i.e., the spur wheel is five times the size of the driving pinion. The motor is provided only with two speeds, one forward and one reverse. It is furthermore provided with a free wheel clutch so that the tractor may be thrown out of action without stopping the engine, and the racing of the latter under such conditions can of course be prevented by retarding the ignition lever in the car.

A NEW RECORD IN HORSE TROTTING.

BY S. W. BALCH.

The gradual lowering of the trotting record during the last century from a mile in three minutes to the new record of Lou Dillon on August 24 has led many to question if a limit is ever to be reached. The mathematician has a rule to guide him in a guess at the answer to just such questions. In 1892 the writer undertook to discover the law of trotting improvement and published his results in the SCIENTIFIC AMERICAN of September 24 of that year. A gradual lessening of the rate of improvement which would indicate an ultimate limit did not then appear. The chart accompanying that article did indicate, however, that at the end of the century the trotting record would lie between 2:03 and 2:04, as has proved to be the case, The Abbott in 1900 lowering the record to 2:03¼.

With our new record a new chart becomes necessary. The vertical lines represent the years in which the record has been lowered, the spaces between the lines indicating the time interval, the length of each vertical line indicating the record for that year.

A curve is next sought that will pass through as many of the points as possible, or close to them, and the continuation of this curve across lines indicating future years shows the best answer to the main question that the facts warrant.

If the curve proves to be a hyperbola, it will afford confidence in the accuracy of the solution, for a peculiar property of the hyperbola is that it constantly approaches but never reaches a straight line called an asymptote, and this asymptote represents the ultimate rate of speed. With Lou Dillon at the two-minute mark, a point is indicated on the chart showing this hyperbolic curve as the law of improvement. It is now possible to pass the curve of a hyperbola through the record points of Trouble in 1826, Dutchman in 1839, Nancy Hanks in 1892, and Lou Dillon in 1903. This curve will be within a few seconds of many other records in which the time was notably reduced.

The hyperbola is represented by the equation

$$xy = 10{,}000,$$

in which x equals the number of years since 1726, y equals the number of seconds over 63½ seconds to trot a mile. The notable records of Maud S. in 1881 and 1885, with the high-wheel sulky are 2¼ to 3¼ seconds above the curve, which would indicate that the change to the pneumatic sulky will account for this measure of the improvement. This curve places the ultimate limit of trotting speed at a mile in 63½ seconds, which, though constantly approached, will never be reached actually, and it indicates the minute and a half mark as two centuries away.

The New Pennsylvania Railroad Bridge.

On August 23 the bridge constructed by the Pennsylvania Railroad Company between Trenton and Morrisville across the Delaware River was opened for eastbound traffic. The new bridge will bring Philadelphia and New York twenty minutes nearer each other. The length of the new structure is 1,080 feet; its width 55 feet. The bridge is wide enough for four tracks, two for passenger service and two for freight and coal trains. With the exception of that at New Brunswick, this is the only bridge on which four parallel tracks are laid.

The actual cost of the bridge was $1,000,000, but about $2,500,000 additional was spent on approaches and in removing several grade crossings. Two bad curves have been done away with, so that much faster time can be made by the trains. The total number of grade crossings abolished between the two cities is 125.

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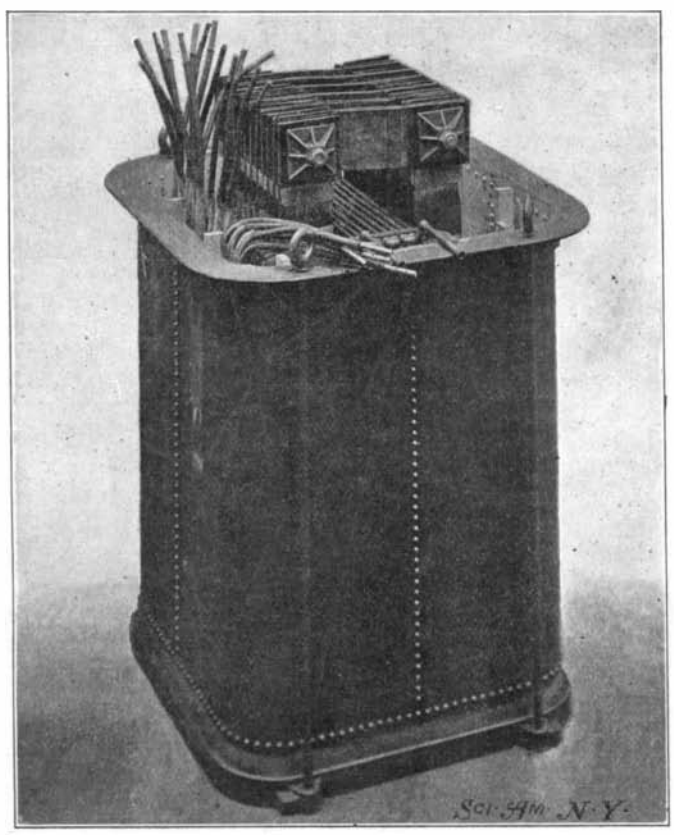
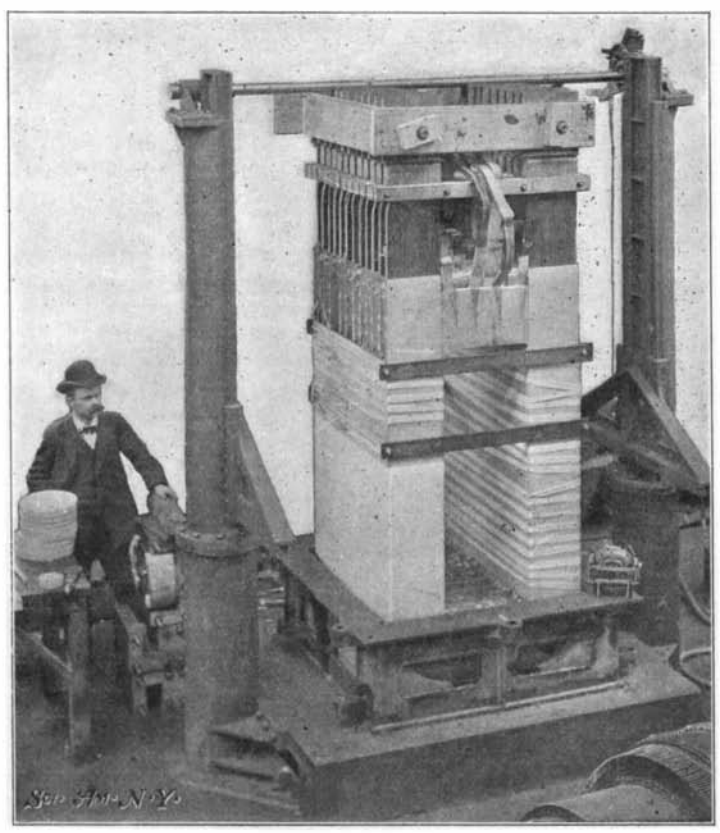
THE LARGEST TRANSFORMER IN THE WORLD.

What is claimed to be the largest transformer in the world has just been built for the Pittsburg Reduction Company, and will be used at their Niagara plant for the manufacture of aluminium by the process of electrolysis. The transformer is rated at 2,000 kilowatts, which is 250 kilowatts more than the capacity of any other transformer with which we are acquainted. But more remarkable still is the unusual quantity of current which is induced in the secondary winding. This large current is required by the peculiarities of the aluminium reduction process, in which the current used may be very heavy, though the voltage must be very low. The primary winding of the transformer is designed to receive a current of 908 amperes at 2,200 volts and this will be transformed in the secondary winding to a current of 40,000 amperes at 50 volts pressure. Our illustrations give an approximate idea of the size of the mammoth transformer. The transformer at its base measures 7 feet 2 inches square and its height is 8 feet 8 inches. One of our views shows the transformer in process of construction, which construction, in view of the unusual capacity of the apparatus, is of special interest. The secondary winding consists of heavy laminated copper bars, a large size being required to carry the enormous current for which the transformer is built. These bars obviously cannot be bent to form coils in the ordinary sense of the word, but are connected at the top and bottom by copper plates clamped thereto. These may be seen best in our other view of the transformer. The primary winding of the transformer is made up of copper ribbon coil-sections, a coil-section being placed between each successive pair of bars in the secondary winding. Taps from each coil section of the primary winding are run up to a switching device called the "regulator head" whereby any number of coils may be cut in or out to change the voltage to any pressure desired, the ratio between the primary and secondary voltages being of course directly proportional to the number of turns in each. The illustration shows the windings complete and ready to receive the iron core. This consists of thin sheets of soft iron built up about the coils. The upper part of the apparatus, after the core is in position, is surrounded by a coil of piping through which cold water is circulated to carry off the heat generated by hysteresis and by the current in overcoming the resistance of the conductors. An additional coil is placed above the primary winding and within the secondary winding as shown in one of our views. The entire apparatus is incased in a tank filled with oil which circulates through the transformer and carries the heat from the lower heated sections to the top where it is taken up by the cooling coils. The oil also serves as an insulating medium in the gaps between the coil sections and between the coils and the iron core. These parts are also separated from each other by sheets of insulating material. The tank in which the transformer is incased is made of heavy boiler plate, which cannot be torn or broken in the event of fire and thereby cause injury to the coils by the release of the oil. The transformer was built by the Stanley Electric Manufacturing Company, and by way of contrast we have shown on the base of the partly completed giant transformer a transformer of one-half kilowatt, which is the smallest transformer built by the Stanley Company.



Top of the Transformer Case Removed, Showing Secondary Windings and Cooling Coils.



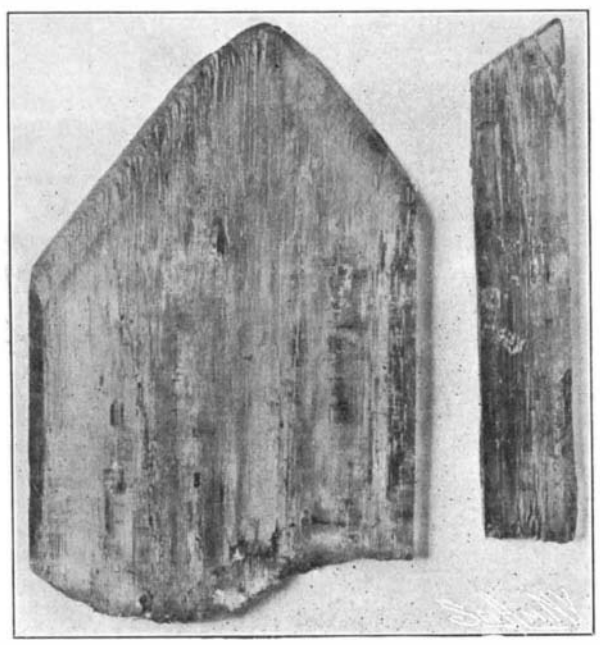
The Transformer in Process of Construction. A ½-Kilowatt Transformer Shown on the Base at the Right.

THE LARGEST TRANSFORMER IN THE WORLD.

VESUVIUS AGAIN BURSTS FORTH.—Another new fissure has formed in Vesuvius about two-thirds up the mountain. Lava is flowing out and has already reached Atrio del Cavallo. This latest eruption occurred without any warning whatever. There was no earthquake, no detonation, no rain of ashes, nothing but a stream of lava and red-hot stones thrown to a height of 700 feet. Lava ran in a stream fourteen feet broad and soon traveled a distance of three-quarters of a mile.

KUNZITE—A NEW GEM.

There is always something particularly interesting in bringing to light a new gem. A remarkable discovery of unaltered lilac-colored spodumene has been recently



Kunzite—A New Gem.

made at Pala, San Diego County, Cal. The new gem was named after its discoverer, Dr. George F. Kunz, the well-known mineralogist and gem expert. The crystals are of extraordinary size, transparency, and beauty, some of them weighing 17 troy ounces. The crystals are flat and the color varies from a very pale tinge to a rich amethystine hue. They have been etched by weathering. They are remarkably free from flaws. The specific gravity of the crystals is 3.183 and the hardness is 7. When cut and mounted parallel to the base the gems are of rare beauty. The new mineral is being analyzed by Dr. Charles Baskerville, of the University of North Carolina, who suggested the name "Kunzite."

By the action of Röntgen rays Dr. Baskerville excited a crystal of the new mineral sufficiently to make it photograph itself when placed upon a sensitive plate and kept in the dark for ten minutes.

In course of the tests by Dr. Baskerville the Kunzite crystals were subjected to the action of ultra-violet light without showing any evidence of fluorescence or phosphorescence, and it was not until it was subjected to the bombardment of X-rays of very high penetration that it became at all fluorescent. On its removal to a dark chamber, it exhibited a persistent white luminosity never before observed in its class of minerals.

The traffic receipts of the Forth Bridge for the past half year were $365,000, an increase of $12,500.

Some Postal Figures.

Postal and telegraphic statistics for 1900 which have just been printed in the Statistical Yearbook for the German Empire, show the following figures, says Simon W. Hanauer, deputy consul-general at Frankfort, in a report to the State Department.

Germany had in that year 44,775 post offices, following next to the United States, which had 77,957. Great Britain had 22,194, France (including Algeria), about 11,000; Italy, nearly 8,000; Austria-Hungary and Russia about 6,000 each.

In the number of persons employed in European postal departments, Germany stands first with 222,800; Great Britain, 173,184; France, 77,245; Italy, 74,958; Russia, 56,217; and Austria-Hungary, 67,584.

Letters and postal cards forwarded by the public mails in 1900 were taken, in round numbers, as follows:

United States	7,250,000,000
Great Britain and Germany each about	3,500,000,000
France	2,250,000,000
Austria-Hungary	1,000,000,000
Italy	755,000,000
Japan	730,000,000
Russia	566,000,000

Nearly one-third of the total for Germany consisted of postal cards, while only one-twelfth of the total figures for the United States were postal cards. This difference is attributed to the saving spirit of the Germans.

In 1900 Germany had 24,471 telegraph offices, with 36,000 instruments in operation; Great Britain, 11,512 offices and 38,000 instruments, and the United States, 22,954 offices and 81,000 instruments.

The number of telegraphic dispatches transmitted in 1900 was:

Great Britain	92,000,000
United States	63,000,000
France	50,000,000
Germany	46,000,000

In Germany there were 2,411 cities or towns having public municipal telephone systems, with 305,795 connections. France had 1,199 public telephone plants with 72,480 connections.

There are a variety of chemical methods for the synthesis of ether from acetylene, but they are in general indirect, alcohol being formed as an intermediate product. In a method proposed by Joseph W. Harris, and described by Mr. C. P. Townsend in the Electrical World, the transformation, for all practical purposes, is direct. From this description it seems that acetylene is introduced into strong sulphuric acid solution in the cathode compartment of an electrolytic cell, the anode of which is inclosed in a porous cup. The gas reacts with the liberated hydrogen, yielding a mixture of ethylene and ethane, the conditions of the reaction being such as to restrict as far as possible the production of the latter gas. This ethylene, formed in strong sulphuric solution, passes at once into ether, the controlling feature of the reaction being the presence of relatively small percentages of water — not to exceed 35 per cent — in the acid. At lower acid concentrations the formation of alcohol is noted. The author states that the reactions considered most probable by Mr. Harris are as follows: first, acetylene by union with hydrogen passes into ethylene; second, ethylene unites with sulphuric acid to form ethyl-sulphuric acid; and third, ethyl-sulphuric acid in the presence of water breaks up with formation of ether and regeneration of the acid electrolyte. Inasmuch as certain of the known carbides and carbide mixtures react with water with formation of ethylene, it would be interesting to determine whether they would yield some ether by decomposition with strong sulphuric acid.

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A BOLAS-THROWING SPIDER.

BY CHARLES E. HUTCHINSON.

The spider known as *Ordgarius cornigerus Hentz** is spread widely over the United States, but, strange to say, its habits have never been described. It seems to exhibit little choice in its selection of a permanent site, though I have found it less rarely on low-branching cypress trees. It remains secreted during the day, always in the same place, curled up beneath a leaf, limb, or fence rail. For this reason it is almost impossible to find it until it reaches maturity, when its conspicuous egg cocoons tell of its proximity. These, three to five in number, are hung within a few inches of one another, fully exposed to the sun. They are made one at a time at intervals of ten or fifteen days. At night-fall, the spider crawls out to one of the outermost branchlets and there engages in a most wonderful operation.

THE SUBJECT.

The branchlet selected is always one that retains a clear space of at least two or three inches below it when depressed by the spider's weight. A few short threads are first placed irregularly about the extreme tip of the branchlet and along its under side for a distance of several inches, while additional threads are carried out to adjacent branches to lend stability to the part.

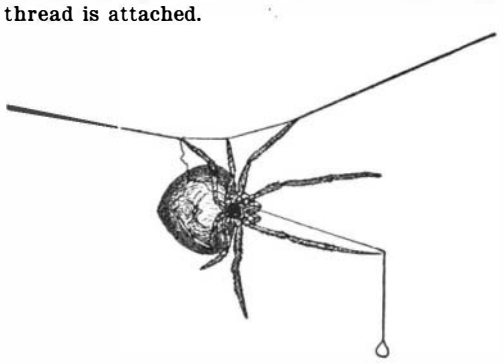
The spider now hangs back downward by its legs to the lower threads stretched along the under side of the branchlet. Attaching a new thread to one of the others near one end, it crawls along the horizontally inclined threads below the branchlet, drawing out the new thread the while from its spinning organ to the length of about two inches. The thread naturally falls below the others, the spider taking care that it shall remain free from entanglement.

The spider with its newly drawn thread still attached now exudes a very small quantity of viscid matter upon the thread at its juncture with the spinnerets. No other part of this thread bears any viscid matter nor is any subsequently added.

Pressing the tips of its hind legs firmly upon the thread it pushes each leg backward, alternately, allowing the thread to slip between the short, stiff hairs which clothe them. With each extension a small quantity of viscid matter is pushed outward and away from the abdomen as far as the leg will reach. At the end of about twenty seconds, during which time each leg is extended eight or ten times, there results a globule averaging about 3-32 inch in diameter.

This finished, the spider undertakes to release itself by severing the line between its body and the globule. Obviously to release the ball suddenly, fastened as it is to a nearly horizontal line, would be to allow an oscillation which might readily result in some sort of entanglement and the consequent destruction of the pendulum. To guard against such an occurrence the spider first lengthens the line by playing it out hand over hand, as it were, precisely as a human might perform a like operation, save that legs were used in the place of arms, the foot being well fitted to grasp and hold a thread.

The ball having been carefully lowered until its supporting line hangs vertically, or nearly so, the thread running to the spider is severed by a dexterous movement of the clawed foot, the free end losing itself in the globule. As soon as the thread is cut the spider turns about and approaching the pendulum thread siezes it from above with its legs. In this act the performer hangs by two or more of the legs of one side to the horizontally inclined thread to which the pendulum thread is attached.



WAITING FOR A MOTH.

Reaching well down with one of its long, arm-like fore legs it grasps the pendulum thread between the claws with which the leg is tipped, about half an inch above the ball. By a few well directed movements of the other limbs the upper part of the thread is quickly passed under one of the short palps or mouth appendages from which the thread continues to its point of attachment to the main line, the upper portion more often remaining slack. The two fore legs extend horizontally to their full length like the shafts of a wagon save that one is above the other.

If the writer's description is clear the reader now perceives the spider holding in its hand, as it were, a line to the lower end of which is attached a globule; the whole forming a most singular and ingenious contrivance designed for a useful purpose. In this position the spider may remain by the half-hour scarcely moving except to lower its weighted leg for a brief interval from time to time, presumably to rest it. Should the spider remain in this attitude for thirty or forty minutes the verdant observer may be astonished to see the ball carefully transferred to the spider's mouth and disappear forthwith. I have tried to find a reason for this action and think one may be found in the impaired viscidity of the globule due to exposure, as this, transferred to a piece of glass, seems to show deterioration at the end of an hour. Should the ball be swallowed a new one is made, usually within a few minutes, and hung out as was the other.

If now the observer is to be rewarded he will see, by the light of the moon, a large moth approaching, flying slowly along as though searching for something. As the marked victim draws near the spider gathers itself for a supreme effort. The ball-supporting leg points straight down. The body swings about, if necessary, to assume a favorable position with reference to the moth. As the insect comes within the carefully measured limit the spider draws back the bolas supporting leg and with a pendulum-like movement swings it rapidly forward in the direction of the moth. The ball is directed with almost unerring aim and finds lodgment on some portion of the victim. In nearly every instance it strikes a wing, a part to which it is probably particularly directed. Its violent contact with that rapidly moving member insures a wide and firm attachment.

The moth finding itself fast flutters violently in an attempt to free itself, but the assailant drops quickly down from its trapeze and sinks its fangs into a vital part. In its descent it follows along the bolas line, but is supported by a new thread which it spins as it goes—an admirable provision against a fall. By reason of the poison injected the moth is soon paralyzed, after which it is carefully enswathed in bands of silk.

Even the light of a full moon is not sufficient to disclose this wonderful operation satisfactorily and an artificial light is a disturbing element to the moth. To avoid these objectionable conditions and the annoyance of waiting indefinitely it is only necessary for the observer to catch a moth and, seizing it by the wings of one side, between the thumb and finger, move it within striking distance of the spider. A common lamp may be held quite near without affecting the spider in the least. The free wings of the moth must be in rapid vibration or the spider will not notice it. As soon as the strike is made the moth may be freed from the hand with the assurance that it cannot escape. The moth selected should be one whose wing expanse does not much exceed two inches, otherwise the spider will be likely to refuse it, although the snare is strong enough to hold a much larger one.

The globule is whitish or watery in appearance, apparently odorless, and may be tasteless, though I fancied that I detected a slight peppery taste. If an object be placed in contact with it and drawn back the globule will cling to the object and a prolongation of the supporting thread will be drawn out of the mass, which becomes correspondingly reduced. This addition to the original thread will prove markedly elastic and there will exist a tendency in the remainder of the mass to recover the thread or part drawn out. However, should the thread be drawn beyond a certain point its reversion will not be complete.

It would seem that this elasticity of the thread should be of considerable importance in mimimizing the strains put upon it by the struggling captive. However, one might at first thought overestimate the importance of this property, for the insect selected for the sacrifice is seldom strong enough to affect it greatly. Moreover, the viscid matter spreads considerably when it strikes and cannot, therefore, be drawn out save to a small extent.

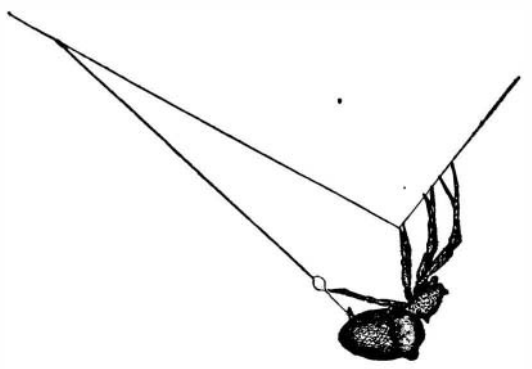
Some effort has been made to learn what means the spider employs to bring its prey within reach. Whether it is some agreeable odor emitted by the arachnid or from its weapon, or whether the prey comes accidentally within reach is a problem of some interest. While the evidence gathered is wholly negative it seems to support the conclusion that the spider does emit such an odor. None, however, is perceptible to human nostrils except when the arachnid is roughly handled, when a very noticeable sour-bitter odor is encountered. This arises from an amber-colored emission from the mouth. Small pieces of cloth scented with this failed to attract a single moth, though several passed by at no great distance.

But in view of the limited number of moths ordinarily about in this region and the almost unfailing success of the spider in making a capture during a night, the odor theory is given weight. Were the spider not dependent upon its individual resources we should expect to find it hanging from a moth-attracting flower, or at least upon a plant bearing such flowers.

* For the name of this spider I am indebted to Nathan Banks, Washington, D. C.

Artificial Pumice.

While emery is used for sharpening tools, sand for polishing stones and glass, oxide of iron for fine glass, and chalk and felt for metal ware, pumice is most frequently used for sharpening soft materials. Pumice stone is unreliable, both in grain and hardness.



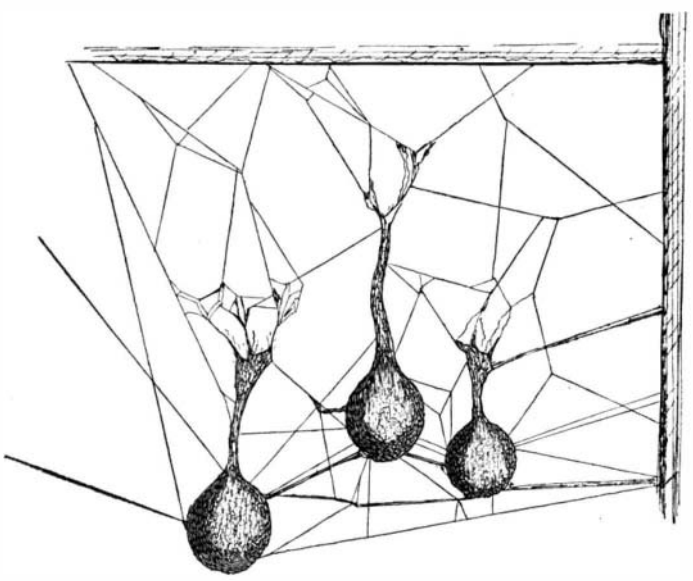
MAKING THE GLOBULE.

Variations have been noted even in the same piece. This has suggested the idea of replacing it with artificial pumice.

The factory of Schumacher, at Bietigheim, in the valley of the Enz, has been manufacturing an artificial pumice stone out of ground sandstone and clay for some time, and it is interesting to note to what extent this manufacturer has tried to adapt his products to the various purposes for which they are required. There are on the whole ten kinds, differing from each other in regard to hardness and grain, viz.: There is (1) a hard and a soft kind with coarse grain, particularly useful in the leather, wax-cloth, felt, and wood industries; (2) a hard and a soft kind with medium coarse grain, suited to stucco-workers and sculptors and particularly useful for polishing wood before it is painted; (3) a soft, fine-grained stone for the white and dry polish of wood and for tin goods; (4) one of medium hardness with fine grain, for giving the wood a surface for an oil polish; (5) a hard, fine-grained one for working metals and stones, especially lithographic stones; and finally pumice stones with a very fine grain. These artificial stones are used in pretty much the same way as those of volcanic origin. For giving a smooth surface to wood, a dry stone is applied, but to give it a fine polish the stone is dipped in oil. For fine work no coarse-grained and for coarse work no fine-grained stones are used.

Robespierre and Franklin.

The library of the University of Pennsylvania has acquired about five hundred manuscripts, once the property of Benjamin Franklin, which are of considerable historical value. Among them is an original letter from Maximilien Robespierre, the leader of the revolutionary period during the Reign of Terror in 1794.



A CLUSTER OF EGG COCOONS.

The letter was written in 1783 from Arras, France, Robespierre's native town, where he was then practising law as an advocate. In it he says that he is sending to Franklin a brief of a case in which he had defended, before the council of Artois, the use of Franklin's invention—lightning rods. Another company had secured a judgment preventing their use, but Robespierre was successful in inducing his fellow citizens to avail themselves of the discovery.

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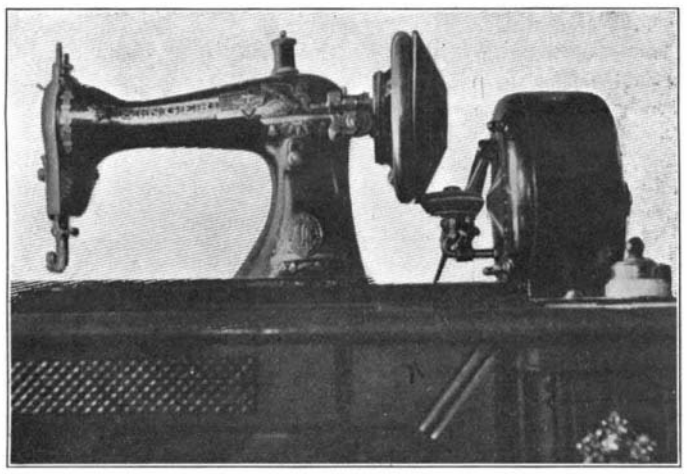
Patent Department

VARIABLE SPEED GEAR FOR MOTOR-DRIVEN SEWING MACHINES.

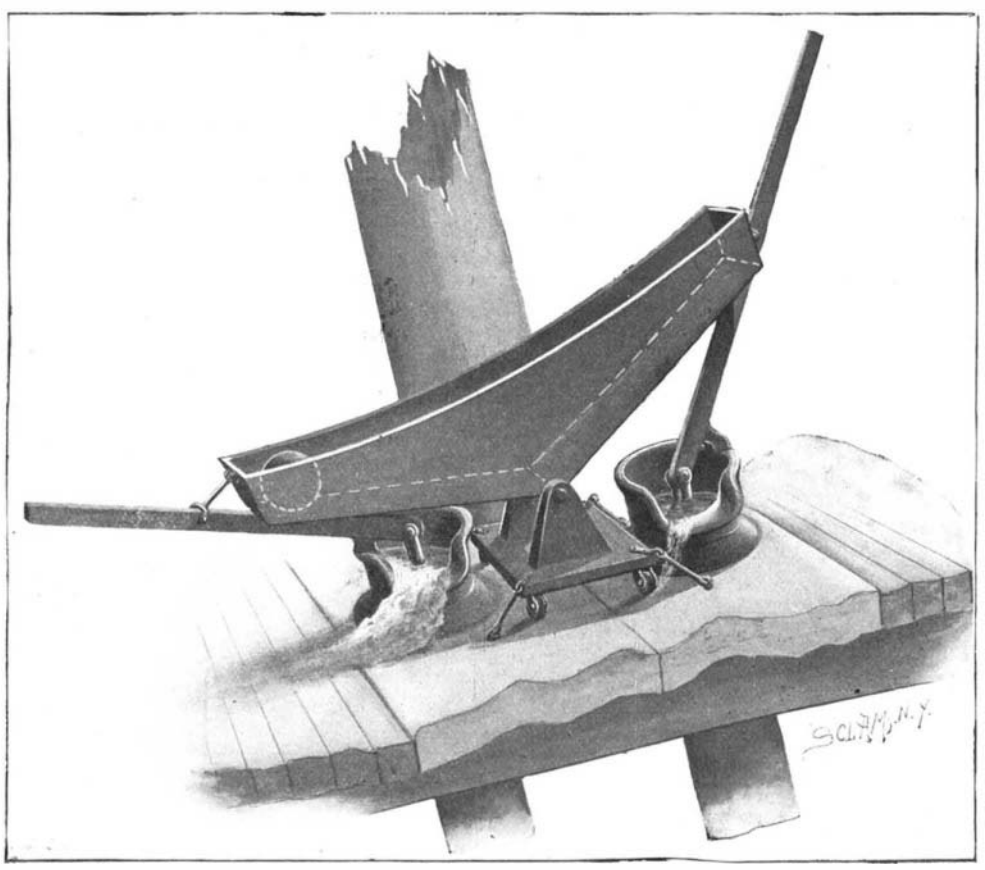
The advantages of using an electric motor to operate a sewing machine are greatly increased by the provision of a positive mechanical means for changing the speed of the machine to suit varying requirements. Our illustration shows a simple gear designed to accomplish this result, which is the invention of Mr. Edward P. Dawson, of 708 South Main Street, Butte, Mont. The gear is very simple and contains no parts which are liable to get out of order. Secured to the driving shaft of the sewing machine is a cone which faces a similar cone secured to the armature shaft of the motor. The cones are spaced apart, the axis of the motor cone lying above the periphery of the other cone, so that their adjacent faces are parallel. A friction wheel is located between the cones in such position that its periphery will engage their faces. The friction wheel is mounted in a slide adapted to travel in guide rods projecting from the motor and lying parallel with the upper face of the motor cone. Normally, the wheel is held in its lowest position by means of a spring acting on a lever connected with the slide, but by means of a cord the outer end of the lever may be drawn down, thus raising the wheel. On operating the motor motion is transmitted from one cone to the other by frictional contact with the intermediate wheel and obviously by raising and lowering the wheel the speed of the machine may be easily varied to any degree desired. The gear shown in our illustration has been in use for six months and we are informed has given perfect satisfaction.



VARIABLE SPEED GEAR FOR MOTOR-DRIVEN SEWING MACHINES.

WAVE MOTOR FOR PUMPING SHIPS.

"What can't be cured must be endured," says an old proverb, but the Yankee version reads: "What can't be cured must be put to some use," and a capital illustration of this appears in the accompanying engraving, which shows a device adapted to use the rolling motion of a ship to work the vessel's pumps. The invention, which is to be credited to Mr. David L. Bradly, editor of the American Ship Builder, New York city, is simplicity itself, comprising merely a trough hinged at the center to a standard and secured at its outer ends to the handles of the pumps. The motion of the vessel causes a heavy ball in the trough to roll from one end to the other, rocking the trough up and down, and thus operating the pumps. Since the pumps practically balance each other the weight of the ball when two pumps are used need be but little greater than the weight of water lifted at a single stroke of one of the pistons. Ships at sea, particularly coastwise vessels, ordinarily roll much more than they pitch; but if at any time it be desired to use the pitching movement of a vessel the rocker trough can be disconnected from one of the pumps and the platform on which the rocker is mounted may be easily swung about to the desired angle and secured by hooks. The simplicity and compactness of the motor should appeal to the captains and owners of all schooners or barges, for they will find it very effective, requiring no attention, costing nothing for operating power, having no intricate parts liable to get out of order, and which at the same time occupies a minimum of deck space, which is so valuable for the stowage of freight.



WORKING A VESSEL'S PUMPS BY MEANS OF A WAVE MOTOR.

A School of Invention.

A manufacturer at Newburg, N. Y., Mr. Thomas Coldwell, himself an inventor of some repute, advocates a new study in the public schools, the cultivation of genius and particularly of inventive genius. In a letter written to the Newburg Journal, from which we make the following extract, Mr. Coldwell outlines his interesting plan.

"Some children show a greater natural taste or inclination for arithmetic or grammar, or any other line of education, than do others, and yet we give them all the same general education, regardless of their natural taste and often through persistent study and encouragement some of the dullest scholars at the start graduate with the highest honors and become our brightest and most successful men.

"If this be true in regard to developing genius in these general and popular lines of education, why not in the line of inventive genius? And why should not every boy be given the privilege of developing himself in this line as well as in any other? I know that inventors generally are looked upon as dreamers and cranks, but the world would be in a sorry plight without them. Next to religion we are indebted to them for our advanced civilization more than any other one thing.

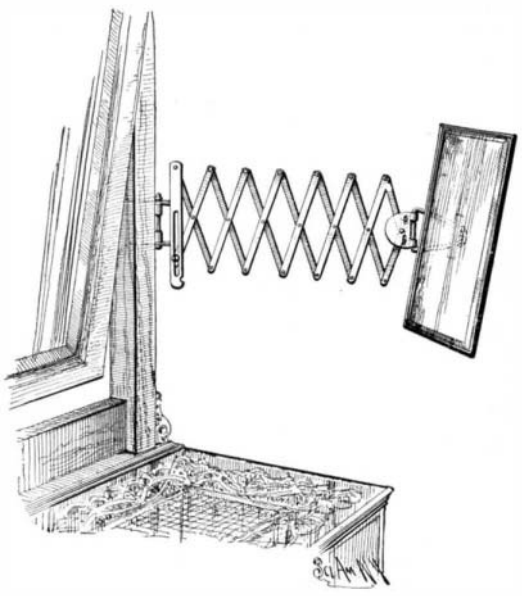
"To give this a practical test I would suggest that our Board of Education offer prizes in the manual training department for the best inventions or improvements in connection with their work, or tools, either in inventing something entirely new, or any improvement in old things, or any suggestions for improvements in connection with the same.

"If the Board of Education have not the power to offer these prizes, they might allow private individuals to do it. I have tried this plan in our factory, and have been surprised at the development of inventive genius among the men. During the first six months we had only eleven suggestions for improvements; during the fourth six months we had over seventy. And this rapid development was from men who had shown no marked genius in this line previously."

If the prominence of his witnesses is any criterion, Lloyd Collis, of New York city, must certainly possess a valuable patent. The patent covers an improved car coupling. As witnesses to the inventor's signature we note on the drawing the names of Collis P. Huntington and W. L. Strong and on the specifications the names of Chauncey M. Depew and George J. Gould.

ODDITIES IN INVENTION.

MIRROR SUPPORT.—The advantage of having a small mirror attached to a bureau mirror by an extensible bracket is readily apparent, permitting, as it does, the use of both hands when viewing one's reflection at different angles. Nevertheless such an attachment is liable to prove a great annoyance unless it can be compactly folded up when not in use. A bracket which can thus be folded is provided by a recent invention, and is illustrated herewith. It consists of a lazy tongs extending from a bar which is hinged to the bureau. One of the links of the lazy tongs is pivotally connected with the upper end of this bar, while the other adjacent link is provided with a pivot-stud which passes through a slot in the bar and may be secured thereto by a thumb-nut. Obviously on raising or lowering this stud in the slot the bracket can be extended or retracted to any desired extent. The small mirror is mounted on the end of the bracket in such manner that it can be turned to any angle. The entire bracket also can be swung in a horizontal plane to any required position.



MIRROR SUPPORT.

TARGET PRACTICE WITHOUT AMMUNITION.—The raw recruit may now be perfected in target practice without wasting any ammunition or exposing himself and others to the dangers resulting from carelessness and poor marksmanship. This can be accomplished by using a new apparatus recently patented by a Swedish inventor. The apparatus comprises a dummy gun mounted upon a universally jointed support which permits the gun to be pointed to any desired direction. A pointer co-operates with this support to indicate even the slightest movements of the gun. The parts are normally so adjusted that when the gun is aimed directly at the target the pointer registers with a bull's-eye mark at the center of a glass disk on the front of the apparatus. A clamping device is actuated, when the trigger is pulled, to lock all the parts against further movement. Deviations from the proper aim may be then determined by noting the position of the pointer. In practice it may be found desirable to secure a mirror in front of the registering disk so as to reflect the position of the pointer to the marksman. The unskillful operator being provided with a registering target close at hand can thus more readily observe his defective aim and more quickly learn to perfect himself in target practice.

TARGET PRACTICE WITHOUT AMMUNITION.

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Brief Notes Concerning Inventions.

Charles Filer, who was paroled recently from the Trenton State Prison for good conduct, is the inventor of a blind lock stitch sewing machine which he devised while serving his fourth term for burglary. The machine is said to have been patented in thirty-four countries, and its inventor is reported to have received large sums for his patent rights. Filer is about forty-two years old and has spent nearly twenty years of his life in prison. He claims that all his good fortune sprang from his imprisonment, for if he had not been forced to work in the prison tailor-shop he would never have thought of the blind-lock stitch-machine.

During his lifetime, Charles L. Pullman, brother of George Pullman, invented a number of devices for different purposes, and he spent the greater part of his time before his death in the endeavor to introduce these inventions and get some substantial recognition of the value of the devices. One of them, an automatic means of ventilation, has proven to have considerable merit, and is now being exploited by quite a powerful concern with a manufactory at York, Penn. The system is said to be adapted to the ventilatien of street and railroad cars as well as all kinds of buildings, and it has been adopted in the construction of a number of office buildings. The feature of the Pullman apparatus is that the flow of air is so regulated by means of an automatically-operated valve, that there is a constant inflow of air without any objectionable draft and at the same time excluding the rain and dust. Some of these ventilators are in operation in the White House.

An improvement in the construction of freight cars, designed to facilitate the handling of grain, has been made recently by J. L. Hamel, a millwright formerly of Grafton, N. D., but now employed in a Minneapolis grain mill. His design of car is particularly intended for the unloading of grain, which operation is performed in a remarkably short time as compared with the old method. This is done without the removal of the side doors, there being openings in the bottom of the car, manipulated entirely from the outside by means of a convenient lever. It is necessary only to run the car over a hopper and open the valves, and the grain runs out by its own weight without any further attention. There is provision for covering these openings in the floor when it is desired for the purpose of loading some other character of freight. A car can be emptied in this manner in from three to five minutes.

The method of bringing a vessel to a stop by the use of brakes in the shape of fins fixed along the side of the hull below the water-line, has recently received the indorsement of an agent of the Canadian government appointed to examine into the merits of the scheme. The Canadian government turned over the steamer "Eureka" to the inventor of this system, Louis Lacoste, and James Bowdin, Master of Dredging of the Harbor of Montreal, was appointed to witness the tests, which were made in the rapids of the St. Lawrence River in the vicinity of Montreal. In his report, Mr. Bowdin says the experiments were entirely successful. He says that after the steamer had attained a speed of eleven miles an hour, the fins were opened and the steam shut off, and the craft was brought to a full stop in less than her own length. Many tests of stopping the boat under different circumstances were made, and all were said to be very successful. In the matter of turning the boat with the aid of the fin brakes, it was found that she could very readily be reversed in her own length. In order to test the strength of the brakes, one of them was opened as the boat was proceeding at full speed, and it successfully withstood this severe trial.

By the means of a new attachment to a flute, there is secured a hitherto unknown quality of music which is a combination of the flute and the clarionet. The invention consists of a reed head which is transversely fitted to the head of the flute in such a manner that it may be turned around the barrel of the instrument freely. If the music to be performed calls for the ordinary flute, the regular mouth hole of the instrument is used, the reed head being slipped out of the way. If within the range of the clarionet, and even below the range of that instrument, the mouthpiece is turned around until it covers the hole and forms the "duo flute," as it is called. This change from one to the other can be made instantly and entirely without the use of the fingers, or even removing them from the keys, the musician using his lips for the purpose. The effect secured is said to be richer than the clarionet, something like the violoncello, and even more mellow than the saxophone. Another important feature is the wonderful diminuendo and crescendo possibilities. The volume of the tone can be swelled or diminished better than in any other reed instrument. The duo flute can be tuned by the performer to be in accord with the pitch of any other instrument. This remarkable instrument is the invention of E. P. Rogers, of New York, the son of the cashier of the Nassau National Bank of that city.

Legal Notes.

The Meaning of "Unfair Competition."—The case of Allen B. Wrisley Company vs. Iowa Soap Company contains an excellent discussion of what is meant by "unfair competition in trade." (122 Fed. Rep. 796.)

The complainant company manufactured from 1876 until the commencement of the suit a soap branded "Old Country Soap." In 1898 the defendant company began to make soap which it likewise branded "Old Country Soap."

It is a well-known rule of law that geographical terms as well as words in common use to designate a locality, cannot be monopolized as trade-marks. The term "Old Country" is obviously such a term. The Court of Appeals, before whom the case finally came for decision, confirmed the decision of the Circuit Court, and held that the bill could not be sustained for infringement of a technical trade-mark.

The use of geographical or descriptive words to institute or maintain unfair competition may, however, be lawfully enjoined by a court of equity to the same extent as the use of any other terms or symbols, on the ground of unfair competition. Deceit is the basis of suits of this character. The intention to palm off one's goods as those of another, and the use of suitable means to effect that intention, are both essential elements of a good cause of action for unfair competition. Intent to deceive, coupled with actual means calculated to convey a false impression, is necessary. "In searching for this intention, however," said the Court, "and considering the means adopted by a manufacturer in selling his wares, it must be remembered that the intent to institute or maintain unfair competition and the use of reasonable means to effect this purpose, are to be commended and permitted, not restrained. Every manufacturer has the right to sell the goods he makes or owns to the public, to his own customers, or to the customers of his competitors—if he can—at lower prices, and on better terms than those furnished by them, and by these, and by all fair means, to divert their trade to himself, even though his activity and enterprise may destroy the business of his rivals. The only intention the law condemns is the purpose of a manufacturer or vendor to palm off his own goods as those of his competitors, and the only acts from which such an intention may be lawfully inferred are those whose natural and probable effect is to perpetrate such a fraud."

It would follow from this, that the line of demarcation between acts indicative of a lawful and of an unlawful intention runs wide and clear between those which would, and those which would not be likely to induce the common purchaser, when exercising ordinary care, to buy the article of the vendor as the product or property of his competitor. The duty is imposed upon every manufacturer or vendor so to distinguish the article he makes or the goods he sells, from those of his rival, that neither the name nor the dress is likely to deceive the public or mislead the common buyer. He is not required to insure to the negligent or the indifferent a knowledge of the manufacture or the ownership of the articles he presents. His competitor has no better right to a monopoly of trade of the careless and indifferent than he has, and any rule of law which would insure it to either would foster a competition as unfair and unjust as that promoted by the sale of the goods of one manufacturer as that of another.

In the case under discussion by the court, it could not be shown that the defendant intended to palm off his soap as that of the plaintiff, since he had taken care to distinguish his wrappers from those of the complainant.

Are Citations from Law Books Copyrightable?—A very important decision was recently handed down by the Circuit Court of Appeals for the Second Circuit Court in the case of the Edward Thompson Company vs. American Law Book Company (122 Fed. Rep., 922). The complainant is the publisher of two well-known encyclopedias, one of American and English law, the other of pleading and practice. The defendant is compiling a work called "The Cyclopedia of Law and Procedure," two volumes of which were published when the suit was commenced in 1901. The complainant alleged that these volumes were infringements of its copyright.

The court compared the methods of compilation employed both by complainant and defendant. They certainly show that no very great amount of work is necessary in the production of the bulky volumes which cover a majestic yard or two of the shelves of a law library. The complainant's method was as follows:

When a topic was assigned to a writer, paragraphs cut from the United States Digest, the American Digest, and Jacob's Fisher's Digest bearing upon the subject in question were placed in his hands. In this way the writer, without any labor on his part, mental or physical, had before him, not only the authorities collected by others, but also the paragraphs written by others, which were used by him in preparing his article. It is alleged by the defendant that all of the digests thus used were copyrighted and that the copyrights were infringed by the complainant's verbatim appropriation of a large number of these paragraphs, and that, in any event, having adopted the same method which it now denounces as piratical, the complainant is not entitled to equitable relief. The defendant's method was similar to that of the complainant except that it obtained from the owners of the copyrighted digests the right to use these works.

The only act of the defendant which is complained of is this: Lists of all the cases bearing upon a given subject, including the cases found in complainant's books, were put in the hands of the editor chosen to develop that subject. The list of complainant's cases contained authorities not found in the digests. The original reports of these cases were examined by the editor, and if the cases were found applicable, they were cited by him in support of his article; if not, they were rejected. There is no pretense that a word of the complainant's text has been copied; in fact the defendant's editors were not permitted to open the complainant's books. The list of cases furnished the editor was not copied in the defendant's work and the only use made of the list was as a guide to the volumes where the cases were reported.

The question, therefore, presented to the court was briefly this: Is a copyrighted law book infringed by a subsequent work on the same subject where the only excuse against the author is that he collected all available citations, including those found in the copyrighted work, and after examining them in text books or reports used those which he considered applicable to support his own original text? The court was decidedly of the opinion that no infringement could be charged. If it be held that an author cannot consult authorities collected by his predecessors, the copyright law, enacted to promote the progress of science and useful arts, will retard their progress.

It is well known that Motley produced his great work after years of patient research among the original archives preserved at The Hague and other European capitals and that he brought to light and translated documents which had lain dormant for centuries. The data thus collected enabled him to tread an almost undiscovered path of history. But can it be contended that a subsequent historian of the Netherlands would be debarred from consulting the same sources of information because he was guided to them by a list made up from Motley's footnotes? It is thought not. The literature of the law as it exists to-day is the result of evolution. Each author has had the benefit of all that preceded him and has thus been able to add something to the common fund intended to lighten the labors of the profession. It would be a serious blow to jurisprudence were the rule enunciated that the author of a law book is precluded from taking a list of authorities cited by a previous writer on the same subject and making an independent examination of them. Individuals might profit but the development of legal science would be hampered by such a rule—a rule not of advancement but of retrogression.

The court saw no escape from the conclusion that if the defendant was the infringer so was the complainant, for their methods in examining the authorities cited in prior copyrighted works were substanially identical. A preliminary injunction was therefore refused.

The Effect of Change of Form and Material on Invention.—In the case of Eames vs. the Western Polytechnic Institute it appeared that a simple element in a combination was made in one part instead of two, as in a prior combination. The Circuit Court of Appeals (123 Fed. Rep., 67) decided that this did not alter their substantial identity or avoid anticipation, since it performed the same function and accomplished the same result. In a word, both were mechanically similar. The mere carrying forward or extending the application of a prior device with a change only in degree does not amount to invention.

Similarly in the case of the Drake Castle Pressed Steel Lug Company vs. Brownell & Co. (123 Fed. Rep., 87), it was held that the mere substitution of steel or of wrought iron for cast iron as the material from which a structure is made, does not constitute patentable invention, although such change of material also involves a change in the method of construction and in form, the new device being stamped or swaged from a single sheet of metal where when made it performs the same function in substantially the same way, its only change over the old structure being attributable to the inherent qualities of the materials used.

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RECENTLY PATENTED INVENTIONS.

Electrical Devices.

STORAGE BATTERY.—A. V. MESEROLE, New York, N. Y. Mr. Meserole's invention relates to storage batteries and to other batteries in which active absorbent material is employed for the purpose of supplying an electric current through an electrolyte to fixed conductors or poles; and his object is the production of a form of battery and of elements therefor admitting of general use, and particularly adapted for use in storage batteries of various kinds.

Engineering Improvements.

PROPELLER.—A. C. J. H. MCINTOSH, Eureka, Cal. This propeller acts forcibly against water at all points throughout its working face, owing to the fact that all parts of this face lie at the most efficient angle to the axis of the propeller, and this in turn is due to the plane form of the blade and its position on the hub. Constructed of slightly-resilient metal the blade will in operation expand diametrically at its outer portions not so much from centrifugal force as from the pitch of the blade and its horizontal disposition. The result is a steady increase in the screw diameter in exact proportion to the engine speed, thus gaining propelling power in the screw as the driving effort of the engine increases.

DRAIN-VALVE.—C. A. DUNHAM, Marshalltown, Iowa. This invention has reference to improvements in drain valves or traps, and the object in view is to provide an improved construction and arrangement wherein an expansion chambered diaphragm or disk is not exposed or subjected to any pressure except that which is discharged from the trap, thus making the device more effective and lasting than traps of this class.

Household Utilities.

HEATING APPARATUS.—D. M. HORTON, Fishkill, N. Y. In this patent the invention relates to certain novel features of construction for enabling the inventor to heat various apartments in a building from a single stove or furnace. The improvement is particularly adapted to domestic use, when applied to an ordinary heating-stove in a lower room, with provision for heating rooms above.

EGG-BEATER.—M. SMITH and W. SHERWOOD, New York, N. Y. The invention refers to improvements in devices for beating eggs, cream, spongy compounds, and other substances; and a particular object in view is the provision of a simple and efficient device in which the substance may be warmed or cooled during the operation of beating.

GARMENT-HANGER.—MARY E. PIKE, New Rochelle, N. Y. The purpose of this invention is to provide a garment-hanger especially adapted for hanging skirts and to so construct the device that it will be simple, durable, and economic and adjustable lengthwise, whereby to accommodate itself to any size of waistband, and to provide a supporting device which will enable a number of skirts carried by such hangers to be hung in a closet in a small space.

BED.—C. A. NEEDHAM, New York, N. Y. The mattress in this case is constructed in a number of independent sections, which are capable of being independently placed in and displaced from the bed, such adjustment being effected by moving the section vertically between the side rails of the bed, thus enabling any part of the mattress to be removed by dropping it down from under a patient or to be placed in the bed by a reversal of such movement.

Machines and Mechanical Devices.

COKE-CONVEYER.—E. G. B. KÖRTING, Berlin, Germany. In this case the invention relates to plants for handling coke, and particularly for conveying coke to the crushing mechanism, and has for its object to furnish means for enabling uncrushed coke to be stored during the night without the loss of energy and in the quality of the coke which is experienced with the ordinary procedure. Considerable economy is effected, as a double handling of the coke is avoided.

ASSAYER'S ORE-CRUSHER.—A. C. CALKINS, Los Angeles, Cal. In the present patent the improvement is in the nature of an ore-crusher designed mainly for the use of assayers; and its object is to provide an ore-crusher in which free access may be had to the crushing-chamber to perfectly clean the same, so that the traces of a previous charge may not remain and falsify the assay of subsequent crushings of other samples of ore.

Pertaining to Vehicles.

NOSE-PIECE FOR SLED-RUNNERS.—A. J. PETERTYL, Traverse City, Mich. The object in view of this invention is to provide a metal nose-piece for the front ends of sleigh runners which will afford a continuation of the curvature given to the runners, greatly strengthen wooden runners at the points whereon the nose-pieces are secured by clamping the runners, afford an abutment for the forward ends of the metal soles on the runners, give a shapely design to the upturned front ends of the runners, and confer increased durability thereto.

VEHICLE DRIVING-GEAR.—M. W. TALEN, C. F. PEARSON, E. B. CHRISTOPHER, G. E. JOHNSON, and L. A. LINDBERG, Chicago, Ill. This invention is intended particularly for use on automobiles, and relates to certain novel features residing in a speed-change transmission-gear of the sun-and-planet type and in a novel construction by which this gear is combined with a differential gearing in such a manner as to form a concrete gearing serving the two functions referred to.

SHIFTING-RAIL FOR VEHICLES.—W. B. FLETCHER, Cameron, W. Va. Mr. Fletcher's invention has reference to detachable rails for vehicles; and it consists in a certain construction and arrangement of parts whereby the top or canopy of a vehicle may be easily and quickly removed to form an open vehicle and when replaced the parts will be firmly secured from rattling.

Railways and Their Accessories.

TELPHERAGE SYSTEM.—H. BENTZ, New York, N. Y. This system admits of a great variety of uses. It can be employed in the transmission of mails, telegrams, and parcels, and can be used in stores, factories, and all other places where it is desired to transport comparatively small objects from point to point over predetermined routes. It can be used upon underground routes of every kind and in connection with pneumatic tubes. The number and variety of uses to which the system may be applied is practically without limit.

DYNAMO-GEARING FOR RAILWAY-VEHICLES.—H. WESTON, Perth, Canada. The present invention relates to a dynamo-gearing for railway-vehicles—that is, to means for mounting a dynamo upon a railway-vehicle so as to cause the dynamo to be driven by the revolution of one of the axles of the vehicles. The improvement is particularly useful for driving the dynamos used for lighting and heating passenger cars of all kinds.

CAR-COUPLING.—J. C. YEISER, Austin, Texas. This car-coupling invented by Mr. Yeiser is of the Janney type, and the object of the inventor is to provide novel details of construction for a coupling of the class specified which improve the operation and adapt the couplings in pairs when applied to cars for a reliable coupled connection automatically when one or both cars having the improved couplings approach on a railroad-track that is either straight or curved.

Miscellaneous.

HYDROCARBON VAPOR GENERATOR.—J. F. SHELTON, Fort Worth, Texas. Mr. Shelton is the inventor of an improved apparatus for causing hydrocarbon fluid to vaporize readily. The fluid is fed into pockets which are heated by what is termed the "subflame." The hydrocarbon fluid is vaporized by the heat and is properly aerated while passing to the main burner. The "subflame" is fed from a portion of the fluid vaporized by a local vaporizer.

DENTAL TOOL.—G. B. HOUGH, Somerset, Pa. In this patent the invention relates to a tool intended to hold the "broach" ordinarily used in dentistry for removing the nerve from a tooth. The invention comprises a peculiarly-constructed clamp or chuck to which broaches of numerous kinds are applicable and by means of which the broaches may be held in any desired position with respect to the handle.

BOW.—J. J. ADAMS, Charlotte, N. C. This improvement refers to that form of bow in which the arrow is a captive arrow; that is to say, the arrow is connected to a cord wound upon a spool or reel, by which the flight of the arrow is restrained or controlled and drawn back by means of the cord or the arrow and cord utilized for subsequently carrying a heavier line or rope to or across an elevated or inaccessible point. It is also designed to be used for purposes of sport.

SKETCHING-CAMERA.—W. L. BEEBE and T. A. MCFARLAND, Chicago, Ill. The invention relates to improvements in sketching-cameras, or a "mirrorscope," and one principal object is to provide a simple portable apparatus especially adapted for fieldwork by artists, amateurs, and others in making sketches from nature or objects in general, the use of the instrument facilitating the selection of the view, composition of the scene, and also serving as a color guide.

THROAT-BRACE FOR HORSE-COLLARS.—J. H. MILLER, Duluth, Minn. The object claimed by this inventor is the provision of a novel brace attachment for horse-collars which will strengthen the throat-section of the collar, preventing rupture of the same when the collar is opened at the top for application upon the neck of a horse and also preventing draft strain imposed on the lower portion of the collar from drawing it against the windpipe of the horse, so as to obstruct breathing.

PRINTER'S QUOIN.—W. S. DECKER, Dallas, Texas. In this case the invention has reference to printers' lock-ups; and its object is to provide an improved quoin arranged to insure positive and automatic locking of the wedges and to permit convenient unlocking of the wedges and moving the locking device into an inactive position and retaining it therein.

ART OF PURIFYING ALCOHOLIC LIQUORS.—L. S. HIGHTON, San Francisco, Cal. By this process poisonous and disagreeably-flavored compounds known as "fusel-oils" are removed in whole or in part from raw or immature spiritous liquors, either to produce a practically flavorless and in cases to some extent a neutral spirit for laboratory and pharmaceutical uses or to render such liquors more palatable and wholesome as beverages, to shorten their time of maturation, and to enhance their commercial value.

DESIGN FOR A FINGER-RING.—G. H. HORTH, Hudson Heights, N. J. The particular feature of this design comprises a number of bands forming the body of a ring, the ends of which, terminating in a cluster around a brilliant, serve as claws for setting the stone. The design is graceful and ornamental.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

MARCONI WIRELESS.

Great Fortunes to be Founded in the New System.

When Alexander Graham Bell patented and perfected his telephone, the skeptics were loud in their derision of the "toy." Nevertheless, Bell found believers, and those believers were rewarded for their faith by immense fortunes. Gardner G. Hubbard, the father-in-law and faithful friend of Bell, was the man who risked the most and gained the greatest rewards in backing Bell and the telephone until it reached the stage where the public no longer derided the instrument as a plaything, but clamored for it as a necessity. In the Marconi wireless telegraph there is a parallel of history. Just now in the formative and constructive period, there are doubters and skeptics, but there are some faithful friends, and it is these friends and faithful ones who are going to reap the fortunes that are bound to follow the general adoption of the wireless system. The great advantage of this system over that using wires and cables is its extremely low initial cost, which relieves the company operating it of a large burden of interest, taxes and depreciation, thus increasing its earning capacity many fold.

Those who are investing in the stock of the Marconi Wireless Telegraph Co. of America to-day are the ones who are certain to win great fortunes by the future increase in value of those stocks, as well as through the dividends earned and paid in the interim. Bell Telephone stock increased in value from $1.00 per share to be worth over $1,000 per share, and so Marconi stocks will very likely increase from $4.00, the present price, to over $1,000 within a few years. Thus $80 invested now may become $20,000 within a decade. It is by wise investments such as these that the great fortunes of the big millionaires have been made. The Vanderbilts in railroads, the Goulds in telegraphs and railroads, the Mackays in cables, the Rockefellers in Standard Oil, the Hubbards in telephones. The man who has a few hundred dollars laid away to invest and who has the intelligence to grasp a fleeting opportunity will be the one to seize the Marconi offering and make his fortune.

"The Weekly Marconigram" is the name of a periodical devoted to the new wireless system, and its publishers, Munroe & Munroe, Dept. 10, Broad Exchange Bldg., New York, announce that it will be sent free to all who apply for it.

This firm is known as an aggressive, enterprising combination of brilliant young financiers who have a successful career behind them as a guarantee of their future. They have agreed to keep the Marconi Company supplied with working capital until the system is thoroughly established and in full commercial operation. They have issued a handsome booklet, "Marconi Wireless," giving full particulars concerning Marconi and his system, with 32 illustrations in halftone, which they send free to persons likely to become interested as stockholders in the company.

Mr. George H. Munroe, New York, manager of the firm, says: "We are soliciting the investment of small amounts in Marconi securities for the reason that we believe that the American people will welcome the establishment of this competing system, and because we know that great profits will accrue to the investor from the development of this marvelous invention to a commercial stage. The company has, already, over a quarter of a million dollars invested in stations and apparatus in the United States, but it will require at least as much more before the business can be established upon a highly profitable basis. Once that is done, the value of Marconi securities must necessarily advance very rapidly, and those who buy now will, in the course of a few years, find themselves in possession of securities equally as profitable as Telephone, Western Union and Commercial Cable have heretofore been. If anybody wants to know more about the opportunities this system offers, let him write to us, at Broad Exchange Bldg., and we will be glad to give them."

Business and Personal Wants.

READ THIS COLUMN CAREFULLY.—You will find inquiries for certain classes of articles numbered in consecutive order. If you manufacture these goods write us at once and we will send you the name and address of the party desiring the information. **In every case it is necessary to give the number of the inquiry.**

MUNN & CO.

Marine Iron Works. Chicago. Catalogue free.

Inquiry No. 4532.—For manufacturers of model steam engines.

AUTOS.—Duryea Power Co., Reading, Pa.

Inquiry No. 4533.—Wanted, a large, powerful windmill up to 25 horse power.

Morgan Emery wheels. Box 517, Stroudeburg, Pa.

Inquiry No. 4534.—For manufacturers of the Engineers' Perfection Oilers.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 4535.—For manufacturers of a gas kiln suitable to fire bisque, glass, etc.

Forbridgeerectingengines. J. S. Mundy, Newark, N.J.

Inquiry No. 4536.—For manufacturers of sponging machines, for shrinking cloth.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 4537.—For manufacturers of stand pipes as used in small water systems.

Mechanics' Tools and materials. Net price catalogue. Geo. S. Comstock, Mechanicsburg, Pa.

Inquiry No. 4538.—For machines for turning wood handles for bucket pails, etc.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 4539.—For machinery to manufacture caustic soda out of sulphate and carbonate of soda.

Let me sell your patent. I have buyers waiting. Charles A. Scott, Granite Building, Rochester, N. Y.

Inquiry No. 4540.—For manufacturers of coal and peat briquetting machinery.

For Machine Tools of every description and for Experimental Work call upon Garvin's, 149 Varick, cor. Spring Streets, N. Y.

Inquiry No. 4541.—For dealers in imported and Indian arts, etc.

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 4542.—For manufacturers of a crusher and smelter for a lead mine.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 4543.—For manufacturers of the Marsh steam air compressors for automobiles.

Contract manufacturers of hardware specialties, machinery, stampings, dies, tools, etc. Excellent marketing connections. Edmonds-Metzel Mfg. Co., Chicago.

Inquiry No. 4544.—For manufacturers of mechanical drawing instruments.

Manufacturers of patent articles, dies, metal stamping, screw machine work, hardware specialties, machinery and tools. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 4545.—For manufacturers of articles on royalty.

FOR SALE.—Rights on "Janeric," Liquid Door Check, Nordqvist's U. S. Pat. Oct. 8 1901. C. F. Rennekamp, Sweden, proprietor. Unequaled invention; automatic, adjustable, invisible. Particulars of C. W. Schmidt, 674 E. 154th Street, N. Y. Sole representative for U. S.

Inquiry No. 4546.—For manufacturers of six-inch draw-knives.

ACME SPURS.—Having no way of getting on the market, will sell patent rights; stock made up and material, machines for making (no power required) complete, representing an actual expenditure of $800 for $500 cash. Address Inventor, Lock Box 248, Ossining, New York.

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Inquiry No. 4548.—For manufacturers of gasoline traction engines of small power.

Inquiry No. 4549.—For a burner for burning crude oil for stoves.

Inquiry No. 4550.—For glue manufacturers.

Inquiry No. 4551.—For manufacturers of tin novelties.

Inquiry No. 4552.—For manufacturers of Baxter boiler and engine, also apparatus for cold storage room.

Inquiry No. 4553.—For manufacturers of tapioca machinery.

Inquiry No. 4554.—For manufacturers or wholesale dealers in flower pots.

Inquiry No. 4555.—For manufacturers of shreading machines for heavy work.

Inquiry No. 4556.—For parties making soft steel castings.

Inquiry No. 4557.—For manufacturers of a machine for cross-cutting timber.

Inquiry No. 4558.—For razor concaving and grinding stones.

Inquiry No. 4559.—For manufacturers who make patented articles by contract.

Inquiry No. 4560.—For machinery for preparing and cutting the block mica for market.

Inquiry No. 4561.—For manufacturers of pocket cutlery, razors, scissors, etc.

Inquiry No. 4562.—For blades with edge ground like hack saw blades, but without teeth.

Inquiry No. 4563.—For manufacturers of pantographs.

NEW BOOKS, ETC.

THE HARDENING AND TEMPERING OF STEEL. By F. Reister, London: Scott, Greenwood & Co. New York: D. Van Nostrand Company. 1903. 16mo. Pp. 118. Price $2.50.

A work on this subject is always welcome, and the formulas and other information available by means of this book will prove very valuable to steel workers and tool makers.

MAN AT THIS EARTH to the Man possible of an essential being of the universe. By Leonidas Spratt. Jacksonville, Fla: H. & W. B. Drew Company. 1902. 8vo. Pp. 412.

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Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

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Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(9164) H. B. W. says: Mr. J. has two horizontal tubular boilers 48 inches by 12 feet, + 90 pounds steam pressure on boilers running two engines of 50 horse power each. The past year he used 450 tons bituminous coal to operate the two boilers. What would he save in coal should he install one boiler 66 inches by 18 feet doing the same work as the other two boilers now in use? A. It would require just as much coal to develop 100 horse power from one boiler as it would from two 50 horse power boilers if all other conditions were the same. In installing a new plant it would be probable that some improvements could be made over an old plant, but no direct gain would come from having one boiler instead of two to do the work. 450 tons of bituminous coal per year does not impress us as being a large amount of coal to develop 100 horse power for ten hours a day and 300 days in a year.

(9165) W. F. D. says: Will you please tell me where I can get information concerning the management of small steam launches—I mean the government regulations and rules? A. If you will address the Secretary of the Treasury, Washington, D. C., he will mail you the United States government regulations and rules regarding the use of steam launches and the conditions under which licenses are necessary and can be obtained.

(9166) C. W. S. says: Please give me the serial numbers of SUPPLEMENTS on tools for finding center of the ends of shafting, etc. Also number of SUPPLEMENT on the combination square. A. We would say that the commonest and best tool for this purpose is what is known as a "centering square," which consists of a square with a long blade bisecting the 90-degree angle of the square. This square is used on the end of a shaft much as a T-square is used on a drawing board, and by means of it a diameter of the end of the shaft can always be accurately drawn. By turning the square on the shaft, another diameter, approximately at right angles to the first, can be drawn. The intersection of these two diameters is the true center. There are also a number of machines on the market which drill and counterbore the ends of shafts accurately at their center. See SUPPLEMENT No. 311, mailed for 10 cents.

(9167) F. H. asks: Please let me know how much more power is required to turn a car, trolley, for instance, at an angle of 90 degrees, such as turning a corner, than it does when going straight ahead. A. The power needed to move a car around a curve depends upon the speed, weight, velocity, and length of wheel base of the car, and the radius of curvature of the track. There is, then, no general answer to the question. Some engineers' reference books give figures for particular cases.

(9168) A. V. B. says: Theoretically what are the most favorable conditions for obtaining the greatest efficiency in operating the compound steam engine? I am of the opinion that there are limitations as to length of stroke, point of cut-off, piston speed, and the proportionate size of the high and low pressure cylinders as applied to the locomotive for best possible results. This will of course cover the speed of train, tonnage, etc. To make myself as plain as I can I will state that I am aware that the compound locomotive is in its experimental stage, and I am working on what I think will be an improvement. Locomotives are, as you are aware, designed for high-speed trains and for the purpose of hauling trains where load is the first consideration, speed the secondary. You may construe your answer to the locomotive and where you cannot give proven facts please give your opinion. 1. Theoretically, what are the most favorable conditions for obtaining the greatest efficiency in operating the compound steam engine? A. You ask what are the most favorable conditions theoretically for obtaining the greatest efficiency in operating compound steam engines. In reply we can only say that the conditions of service vary so greatly in high-speed passenger service, with light and heavy trains, in fast freight service, and in freight service where maximum load is the principal consideration, on roads with light grades and curvatures, and on roads where the grades are heavy and the curves sharp, that there is no one set of conditions which will best meet all of the various requirements of this varying service. What is best in one place would not be best in another; also what is best for small locomotives would not be best for locomotives of large power. We think from this you will see that it is impossible to satisfactorily answer the question as you ask it. 2. For given stroke the proportionate diameter of cylinders? Is there any rule for proportioning stroke and diameter of cylinders for given piston speed? (Your opinion and reasons for best practice along these lines.) A. You ask if there is any rule for proportioning stroke and diameter of cylinders for a given piston speed. In reply to this we would say that there is no definite rule, and that the best practice varies quite largely. The practical considerations of the design of the engine largely govern this. With locomotives a 24-inch stroke has come to be regarded as almost a standard, regardless of the diameter of the cylinders, in both simple and compound engines, while the diameter of the cylinder is varied according to the power required. 3. What do you consider the best type of compound engine now operating on the different railroads? (Opinion and reasons.) A. In reply to your question regarding the best type of compound engine, we would say that many types have been suggested, but there are three which have stood the test of service: (No. 1.) The two-cylinder compounds, with the high-pressure cylinder on one side of the locomotive and the low-pressure cylinder on the other side. (No. 2.) The tandem compounds, with the high-pressure cylinder either directly in front of, or behind, the low-pressure cylinder, with both pistons acting on the same piston rod. (No. 3.) The four-cylinder compound, with a high-pressure cylinder either directly above or directly below the low-pressure cylinder on each side of the locomotive, with two piston rods on each side, both acting on a common cross-head. It is impossible for us to say which of these types is the best. Each one has advantages over the others. A greater number of No. 3 type have probably been built than of either of the other two types. The first is the simplest and the cheapest, but has the disadvantage of being the one in which it is most difficult to equalize the work on the two sides of the locomotive. No. 2 simplifies the cross-head construction, and insures that the pressure on it will always be central. It takes up less room vertically, but the cylinder casting projects forward on the locomotive considerably further than on the other types, and on some designs of locomotive this would interfere with the forward truck. The piston valves and steam passages in No. 2 are not quite so simple as they are in No. 3. No. 3 has two pistons, acting on a common cross-head, and with it it is impossible to so perfectly equalize the work done in the two cylinders as to have the pressure on the cross-head always central. On the other hand, the valve mechanism is simple and the cylinder arrangement is compact. You do not directly ask for the area between the high-pressure piston and the low-pressure piston, but it may interest you to know in a general way what ratios have been found most satisfactory. With type No. 1 it is desirable to have the cylinders more nearly equal in size than in the other types, as they are located on opposite sides of the engine. A common ratio here between tne area of the two pistons is 2.25. With type No. 2 common ratio is about 3.50, while with No. 3 the commonest ratio is about 2.75. 4. Which do you consider the best type of compound engine now operating? A. The experience with compound locomotives has been too short for engineers to decide definitely which is the best type. With stationary engines, the cross compound Corliss engine is conceded to be the most economical. The difficulties that have to be overcome with the compound locomotive are: First, the difficulty in starting on grade or under heavy load. Second, the equalizing the work on the two sides of the engine under all conditions of load. Third, the balancing of the reciprocating parts. Fourth, the difficulty of simultaneously varying the cut-off in the two cylinders in such a way as to get the same effect as is obtained by shortening the cut-off in the simple cylinder. Fifth, the increased danger of break-downs due to the more complicated mechanism and the difficulty of getting engineers who can intelligently operate and care for the compound engine. With stationary engines, a gain of nearly 40 to 50 per cent may be obtained by compounding. With locomotives the decreased fuel consumption is not quite so great, 35 per cent being, perhaps, an average figure.

(9169) M. H. says: I have a 40-gallon air tank. The compressed air, when allowed to escape from the tank, possesses a very musty, disagreeable odor. I took the side valve off and emptied a small quantity of rusty-looking liquid. After rinsing it with a solution of potassium permanganate (which remedied the evil somewhat) the air in the tank still smells. I had thought of passing steam through. Or would chlorine do? I must have the air absolutely odorless for my purpose. Can you help me? A. In reply to your question regarding the musty and disagreeable odor from your compressed air tank, we would offer you the following suggestion: If the air which you force into your tank is clean and perfectly dry, and if the tank itself is clean and dry, we do not think that you will have difficulty. First, therefore, clean your tank thoroughly. We would suggest using boiling water, and then drying it thoroughly, heating it for some time, if necessary, to a temperature above 212 degrees. Second, in order to insure that the compressed air which you force in will be clean, cause it to bubble slowly through clean water, and then pass it through a long tube of small lumps of calcium chloride to extract from it all the moisture which it may carry with it from the water which has been used to wash it.

(9170) G. P. K. says: What I want to know is the full value of the increased use of steam as laid down by Emory Edwards in the Axeom, in his work on steam engineering, and upon which he and others attach great importance. To use a little steam at a time, to use it quickly and to keep it hot is the fundamental principle of high rotative speeds, than which there is nothing more practically important in steam engineering. This in a general sense I can understand but what I want to get at is *how much* is gained or lost by rapid or slow use of steam. Suppose an engine is making a certain number of revolutions a minute. How much would be the actual or approximate gain on the basis of the quoted statement—to use that steam twice as fast, everything else being equal? If you have anything that will enlighten me on this subject I would like to get it but would rather some competent person would give as near as possible something more definitely expressed—in figures if possible. This fully dealt with in any work you may supply or in any article you may scientifically treat of I am willing and glad to invest in, as it is a matter I am very much interested in, as there are five engines in this establishment at work at present and I am working on a new plan embodying that principle. The number of engines at work in this region are legion and although the waste is used as fuel there is seldom any surplus of strain and the men who have charge of the engines—well, I will say nothing only that somehow we get along. A. We would say that we regret there is no positive information which we can give you on the subject. If it were not for losses of cylinder condensation, it would make no difference in the economy of an engine whether it should run at high or low speed. One of the principal losses in the steam engine, however, is due to the cylinder condensation, and this loss may be slightly reduced by increasing the speed of the engine. The amount of this reduction will depend entirely upon the design of the engine and the steam pressure that it is working under. There are no experimental data which will enable us to give you any exact figures. In some slow-speed engines the loss due to cylinder condensation amounts to only a few per cent, and in them an increase of the speed would help the economy very little. On the other hand, on some high speed engines there is a loss due to cylinder condensation of at least 15 or 20 per cent, which could, perhaps, be slightly reduced by still further increasing the speed of the engine, but in all probability such gain in economy would be small. There are probably very few cases in which increasing the speed of an engine would decrease the steam consumption by more than about 10 per cent. We regret that there are no exact experimental data on this subject which we can give.

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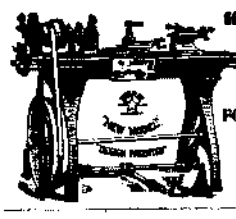

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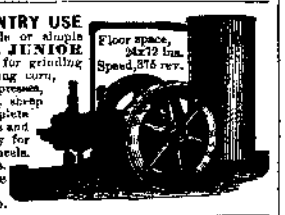

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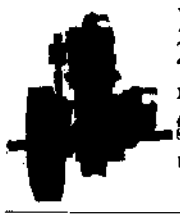

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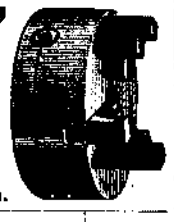

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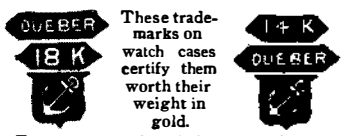

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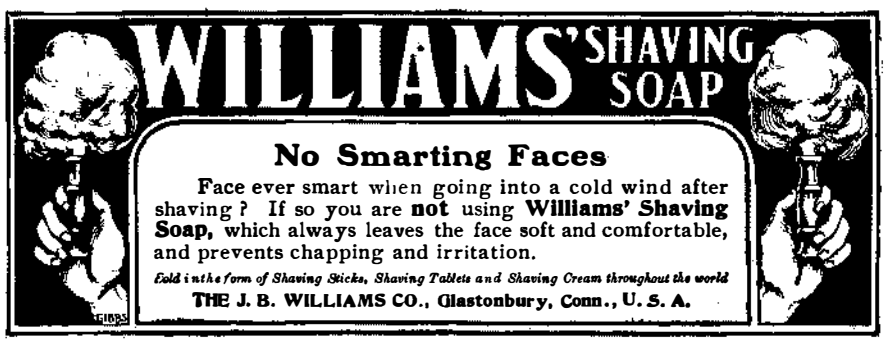
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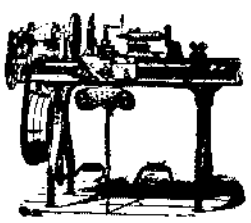

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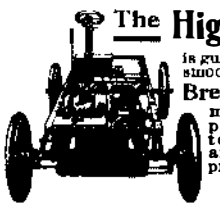

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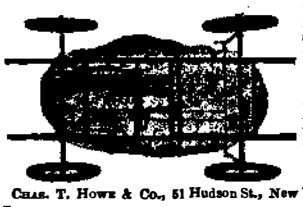

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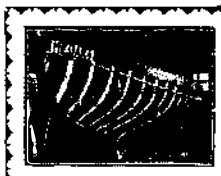

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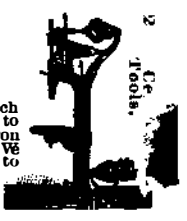

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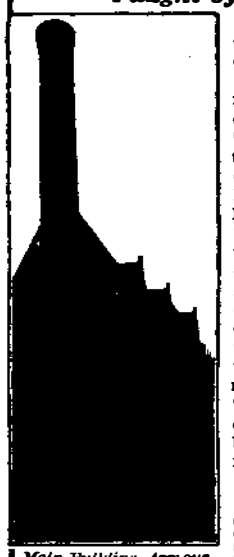

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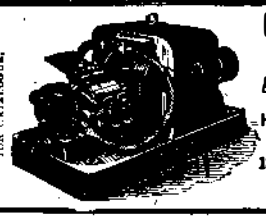

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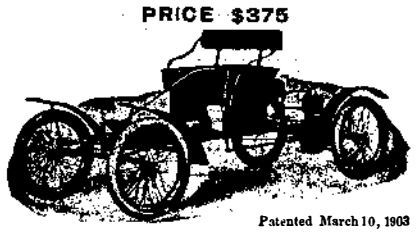

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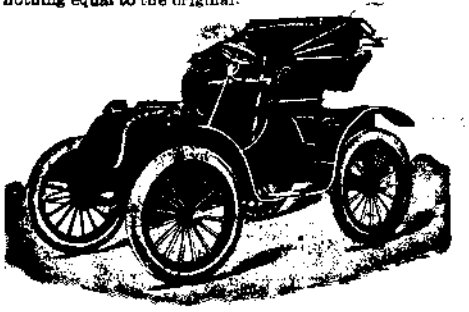

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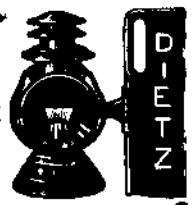

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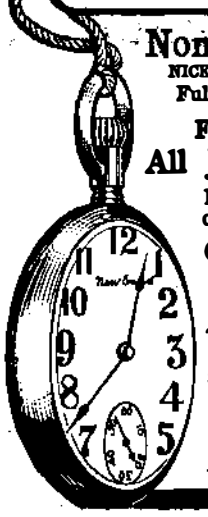

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